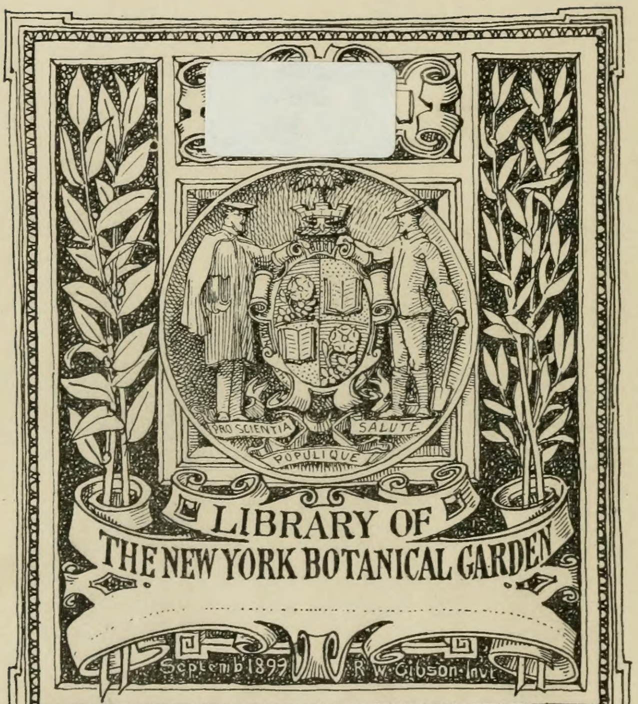
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TWENTY-NINTH ANNUAL REPORT

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Auditor.

Massachusetts Board of Agriculture:

WITH

RETURNS OF THE FINANCES OF THE AGRICULTURAL SOCIETIES,

FOR

1881.

BOSTON:
Rand, Avery, & Co., Printers to the Commonwealth,
117 Franklin Street.
1882.

TWENTY-NINTH ANNUAL REPORT

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SECRETARY

OF THE

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STATE BOARD OF AGRICULTURE, 1882.

Members Ex Officiis.

His Excellency JOHN D. LONG.
His Honor BYRON WESTON.
Hon. HENRY B. PEIRCE, *Secretary of the Commonwealth.*
CHARLES A. GOESSMANN, *State Agricultural Chemist.*
LEVI STOCKBRIDGE, *President Mass. Agricultural College.*

Appointed by the Governor and Council.

	Term Expires.
JAMES S. GRINNELL of Greenfield	1884
JAMES R. NICHOLS of Haverhill	1885
MARSHALL P. WILDER of Boston	1883

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Middlesex	JOHN B. MOORE of Concord	1885
Middlesex North	A. C. VARNUM of Lowell	1883
Middlesex South	S. B. BIRD of Framingham	1884
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Worcester West	E. C. FARNSWORTH of Templeton	1884
Worcester North	GEORGE JEWETT of Fitchburg	1884
Worcester North-West	J. P. LYNDE of Athol	1883
Worcester South	SAMUEL N. GLEASON of Warren	1883
Worcester South-East	VELOROUS TAFT of West Upton	1885
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Hampshire	FLAVEL GAYLORD of Amherst	1883
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Hampden	CHAUNCEY L. BUELL of Ludlow	1885
Hampden East	WILLIAM R. SESSIONS of Hampden	1885
Union	HENRY K. HERRICK of Blandford	1883
Franklin	JOHN S. ANDERSON of Shelburne	1883
Deerfield Valley	ARTHUR A. SMITH of Colrain	1884
Berkshire	HENRY NOBLE of Pittsfield	1885
Hoosac Valley	JAMES M. WATERMAN of Williamstown	1885
Housatonic	MERRITT I. WHEELER of Great Barrington,	1885
Bristol	AVERY P. SLADE of Somerset	1884
Plymouth	JOHN LANE of East Bridgewater	1848
Hingham	EDMUND HERSEY of Hingham	1885
Marshfield	DANIEL E. DAMON of Plymouth	1885
Barnstable	JOSEPH STORY FAY of Wood's Holl	1883
Nantucket	DANIEL ROUND of Nantucket	1885
Martha's Vineyard	DAVID MAYHEW of North Tisbury	1883
Amesbury and Salisbury	J. H. HILL of Amesbury	1884

John E. Russell, *Secretary.*

THE

TWENTY-NINTH ANNUAL REPORT

OF THE

SECRETARY

OF THE

BOARD OF AGRICULTURE.

To the Senate and House of Representatives of the Commonwealth of Massachusetts.

THE Twenty-ninth Annual Report of the Board of Agriculture is respectfully submitted.

The agricultural pursuits of the Commonwealth have not only shared in the general prosperity, but have had increased profit from extraordinary circumstances.

The season of 1881 was unfavorable over the greater portion of the United States. For the first time since annual reports of the farming interest have been made, we have seen a market that has allowed the importation of food from the continent of Europe. Potatoes, cabbages, beans, onions, etc., have been received in large quantities; and small lots of first-class butter have found a remunerative market.

The scarcity that has caused a change in the current of commerce, and made a part of the New World dependent upon the Old for common articles of food, has not been detrimental to the farming interests of Massachusetts.

Though our soil is only productive under skilful cultivation, our seasons are not variable; and the average of crops was well maintained over our whole area, which has resulted greatly to the profit of our farmers.

Prosperity has had the effect of increasing the interest in agricultural pursuits, and has made a very active year for the members of the Board. The plan of "institutes," provided by the Board in 1878, has been greatly enlarged in scope; and the members have been called upon for a great deal of work in connection with this method of disseminating agricultural knowledge and experience. The duties of the secretary have been much increased in connection with this important branch of the business of the Board, every district in the Commonwealth looking to him for occasional assistance.

The lack of late statistics of production makes it impossible to report the condition of our agriculture in figures. Public Document No. 19, of the Department of State, in the Abstract of Polls, Property, and Taxes, records an increase of 13,095 acres of improved land in 1881,—about the same increase as was noted in 1880.

The great advantages offered by sheep-husbandry induce continuous enlargement of our flocks, notwithstanding the risk and annoyance to which we are subjected by the ravages of dogs. In 1880 the increase in the number of sheep was 5,792; but the failure of the Legislature to amend the dog-law in the interest of sheep-husbandry has had a depressing effect, and the past year shows an increase of but 1,656 head of sheep.

It is an anomaly in our civilization, that, in a thrifty society demanding the exercise of every reasonable economy in its varied industries, the oldest and most profitable of pursuits should be thus vexed and prevented. "It is not meet to take the children's bread, and cast it to dogs."

We need sheep to add to the profit of farming, to increase the staple of our important woollen-industry, to assist the food-supply, and to improve the fertility of the soil. The number of sheep in the Commonwealth could be augmented twenty-fold without displacing a single head of cattle. The importance of the matter is awakening the earnest attention of the farmers.

Legislation on this subject is difficult. Owners of dogs are numerous and vigilant. They paid in "licenses" last year about a hundred thousand dollars,—a convenient fund for educational purposes, or the use of town-libraries. Dogs

are the favorite companions of man, and the welcome inmates of the household. Dogs are held by the courts to be property: a farmer must recognize that fact, though the licensed animal may stand before him stained with the blood of the ruined flock. If a dog is valuable property, and useful and profitable to the community, why should he be licensed? We do not take out a license to keep a bull or a boar, often savage and dangerous animals: regarding them as property, we pay taxes upon their value, and become responsible for their actions. Dogs should not be accorded an immunity that is not asked for any other domestic animal.

Nor does it follow that judicious legislation in this matter would reduce the number of useful dogs. On the contrary, it would have a tendency to cause the substitution of honest, valuable animals for the worthless brutes that now infest our villages.

The dairy interest, measured by the assessors' returns, has made no increase during the past year. This falling-off may be explained in various ways. One reason is, that milk-producers, dealing with middlemen, who monopolize the business of Boston, do not realize remunerative prices for milk; but the chief cause may be found in the fear that oleomargarine and other artificial butters would seriously interfere with the domestic manufacture.

The past season has proved that the reduction of the herds has been a sad miscalculation; for, though low-quality butter is still the largest part of our production, and is sold at prices regulated by the oleomargarine factories, good butter is scarce at unprecedented prices.

The manufacture of spurious butter from animal fats, instead of exercising a disastrous effect upon the market, has been a real advantage: it has only competed with poor butter; and many families, suspicious of all low-priced butter, and unable to distinguish the difference in grease, have become purchasers of the better qualities. This is a notable cause of the steady advance in prices.

If farmers were more alive to the great advantage of dealing directly with consumers, they would find that many families can readily be induced to make contracts for butter by the year, knowing it to come direct from the farm. Such customers are of a class that consume generously, and pay full prices.

The time is rapidly coming, in the progress of our farming, when we will look upon the present methods of domestic dairying as wasteful, and an onerous tax upon the hardest-worked portion of the farmer's family.

Butter *has* always been a sure means of getting cash; and this is earned by the hard labor of the women, and often by the sacrifice of health. Much as this labor has been mitigated by the introduction of improved implements, there is a great step yet to be taken in the adoption of the "creamery" system of co-operative butter-making.

This is not an experiment to be tried: it has been in operation for some years, proving highly successful; and we have a proof of the superiority of creamery butter at every market-stall in Boston. When the New-England farmers reluctantly conceded their own grain and cattle market to the Western producer, they thought themselves secure of the monopoly of dairy products. They were safe while the Western farmers followed the old system of domestic dairying, with its careless and varying methods. Upon the establishment of co-operative dairies, taking the cream from hundreds of cows, and producing, under expert management, an unvarying quality of product, the prizes had to be awarded to them, and their butter, without depressing the market, took precedence of ours; for good butter has no difficulty in getting recognition, and generous prices always await it. "There is always room at the top." The superiority of the Western creamery product became especially manifest, when in 1876, at the Centennial Exposition, the gold medals for both spring and fall butter went from the East, — passing the famous dairies of New York, with their century of renown, past the rich farms of Chester and Lancaster Counties in Pennsylvania, where the stone spring houses cool the pans that have made Philadelphia butter the synonyme of dairy excellence, — and were awarded to creameries in Iowa and Illinois.

The Eastern people were not convinced of the situation by this single success; but the next year at Chicago, in a full competition, the creameries of Wisconsin and Illinois were decorated with the medals. At the international shows in New York in 1878 and 1879, Iowa, Wisconsin, and Illinois left only a fifth premium to the Eastern private dairies.

Nor were these temporary successes with special lots of show-butter: they have competed with us in the Boston market; and, leaving out of the question some of the dairies of high repute that have a demand at a fancy price from established customers, the creamery product of Wisconsin, Iowa, and Illinois has brought ten per cent more money in the open market than the choicest New-England product.

This is owing to its high average quality and uniformity, not for one shipment or carload, not for a hundred tubs, but for continuous, sustained excellence of the product from season to season.

Every district where the milk of from two hundred to four hundred cows can be controlled is a proper situation for a creamery. The saving of labor to the women of the household, who are always overburdened, the economy in tools and appliances, in transportation and marketing, are all points in favor of co-operative butter-making

ENSILAGE.

In the report of 1880 I stated that it then appeared that the ensilage system would be valuable only as an auxiliary in feeding our stock.

The claims of the advocates of silos were then very extravagant. It was contended that certain "improved" seed, widely advertised, would produce from forty to seventy tons of corn-fodder to the acre; and the most moderate calculators estimated twenty-five tons as an average crop. It was also asserted that the fermentation of the mass in the silo caused an increase of nutrition in a watery, innutritious crop; that cattle eagerly ate it; and that, with but a moderate addition of nitrogenous food, the flow of milk was greatly augmented, or growth and fat increased. There appeared to be a great saving in the cost of maintenance, and many farmers were led to expensive trials of the system. It has been the endeavor of the Board, by publishing the chemical analyses of ensilage, to give correct statements in regard to its value as a food; and the experiments of those who have planted corn-fodder have reduced the estimate of average yield on our soil to something like twelve tons to the acre.

More cotton-seed or corn meal and bran is required to complete a ration than was expected; and, with the present

state of the evidence, it appears very doubtful if ensilage is to be even an assistance in our system of feeding.

Twelve tons of average ensilage contain but little more than two tons of dry matter, and cost, to raise and harvest, more than thirty dollars. As the same land would produce, with less cost and less trouble, a larger quantity of dry matter in any of our forage crops, and about the same amount of fodder in addition to a crop of ripened corn, it is impossible to figure out a profit.

The advocates of ensilage claim that the average crop will be much larger than I have stated it. Perhaps it may; and, when it is proved to be, the Report of the Board of Agriculture will so state it.

If the average crop of corn-fodder can be increased to twenty tons, which is the heaviest yield reported, and cotton-seed meal remains at its present price, and the health of stock is not affected by the diet, milkmen will have an interest in the system.

At the meeting of the American Dairymen's Association, lately held at Syracuse, N.Y., it was the opinion of that body of practical farmers and butter-makers, that ensilage, with cotton-seed meal, was not the diet for their cows. The necessity is a higher quality of butter rather than a cheaper product. The farmers of the North-west, who are our competitors in the butter-market, will not be met by cream from ensilage and cotton-seed: we must use the best corn-meal raised on our own soil.

The relative value of ensilage and corn-stover, so much discussed, seems fairly settled in the Report (No. 19) of the New Jersey Experiment Station.

GREEN FODDER-CORN; DRIED FODDER-CORN; ENSILAGE.

Two very important questions are considred in the following bulletin: first, Is the loss of food by fermentation, when green fodder-corn is dried in stacks, greater, or less, than when it is preserved in a silo? second, Is ensilage more valuable for milk-production than dried fodder-corn?

To study these questions, an experiment was begun on the College Farm on the first of September, 1881. At that time the corn was in the milk, the stalks were very rich in cane-

sugar, and all conditions, apparently, were favorable for the trial.

The amount of available green fodder-corn, by actual weight, was ten tons. Of this, one half was arranged in the field in fifty small stacks; while the other half, after it had been cut by horse-power into lengths of three-sixteenths of an inch, was closely packed in a silo of about twelve tons' capacity. The analysis of a sample, taken, with the utmost care, to represent the entire quantity used in this experiment, gives the chemical composition of the corn before it was affected either by loss of moisture or by fermentation.

About the last of November, after an exposure to the weather of nearly three months, twelve hundred pounds of the dried stalks were passed through a Lion cutter and crusher, then thoroughly mixed and sampled. The analysis of this sample, compared with that of the original green corn, shows the changes which occurred during the process of field-curing.

On the 23d of December the contents of the silo were found to be in an excellent state of preservation. A sample taken eighteen inches from the surface was entirely free from disagreeable smell, insipid to the taste, and, as shown by the analysis, equal in all respects to the best ensilage which has yet been received at this station. The chemical composition of these three samples can be seen in the following table. It should be remembered that sample No. 1 represents the green corn, while samples Nos. 2 and 3 represent fodders obtained from this corn by two different methods of preservation.

TABLE No. I

	No. 1. Green Stalks.	No. 2. Dried Stalks.	No. 3. Ensilage.
	Per cent.	Per cent.	Per cent.
Water	75.00	39.37	74.70
Ash	1.58	4.63	1.95
Proteine	1.25	3.84	1.75
Fat	.22	.66	.27
Fibre	6.35	18.65	7.86
Carbohydrates	15.60	32.85	13.47
Total	100.00	100.00	100.00

On account of the different amounts of water in these samples, their relative compositions are not plainly seen. Comparisons between them can be easier made by arranging the results in another table, in which the composition of a hundred pounds of the dry matter of each sample is given. Table No. II. is computed for this purpose.

TABLE No. II.

	No. 1. Green Stalks.	No. 2. Dried Stalks.	No. 3. Ensilage.
	Per cent.	Per cent.	Per cent.
Ash	6.32	7.64	7.71
Proteine	5.00	6.33	6.92
Fat	.88	1.09	1.06
Fibre	25.40	30.76	31.07
Carbohydrates . . .	62.40	54.18	53.24
Total	100.00	100.00	100.00

The ash of corn-stalks is that portion which cannot be destroyed by fire. It is not in the least affected by fermentation, nor is it probable that its total amount was in any way changed, either after the corn was packed away in the silo or after it was stacked. It is therefore adopted as a standard in comparing the above analyses.

It has been shown that one hundred pounds of the green corn contained seventy-five pounds of water: four hundred pounds, therefore, of this corn, would have yielded one hundred pounds of dry matter containing six pounds and thirty-two hundredths of ash. The question now is, What is the weight of dry matter in the ensilage and in the field-cured stalks, which contains six pounds and thirty-two hundredths of ash? A simple calculation from the figures in Table No. II. gives the following results: —

TABLE No. III.

	No. 1. Green Stalks.	No. 2. Dried Stalks.	No. 3. Ensilage.
	Pounds.	Pounds.	Pounds.
Ash	6.32	6.32	6.32
Proteine	5.00	5.24	5.67
Fat	.88	.90	.86
Fibre	25.40	25.44	25.49
Carbohydrates . . .	62.40	44.82	43.64
Total weight dry matter .	100.00	82.72	81.98

Eighty-two pounds of the dry matter of the ensilage, and eighty-two pounds and three-quarters of the dry matter of the field-cured stalks, now contain the same weight of ash which one hundred pounds of the dry matter of the green corn contained. During the process of field-curing, therefore, four hundred pounds of green corn lost seventeen pounds and one-quarter of dry matter, while four hundred pounds of green corn packed in a silo lost eighteen pounds of dry matter. Table No. III. shows further, that neither the field-cured corn nor the ensilage suffered a loss of proteine, fat, or fibre, but that the total loss fell upon the class carbohydrates, which includes sugar, starch, etc., — the least costly ingredients of fodders.

Admitting, now, that quite as much of the dry matter of green corn was preserved, in this experiment, by field-curing as by packing in a silo, there remains still several important questions to be considered, — first, Will cows eat the dried corn-fodder as readily and with as little waste as they will eat ensilage? second, How does the milk of cows which are fed dried fodder-corn compare in quantity and quality with the milk of the same cows when ensilage is used?

A feeding-trial was begun on the sixth day of December for the purpose of studying these questions. Four cows were selected from the herd, placed side by side, fed, watered, and exercised at the same time, and for sixty consecutive days treated in all respects as nearly alike as was possible.

During the first period of twenty days, all four cows were fed the same daily ration, made up, for each thousand pounds of live weight, of the following substances: —

	Fat.	Proteine.	Carbohydrates.
	Pound.	Pounds.	Pounds.
20 pounds of dried fodder-corn, containing	.10	.57	7.08
3 pounds winter wheat bran, containing	.10	.40	1.38
30 pounds brewers' grains, containing,	.40	1.58	3 00
Total digestible food . . .	.60	2.55	11.46

The digestibility of the dried corn is here assumed to be the same as green corn.

During the second period of twenty days, the daily ration for two of the cows was the same as during the first period: the other two were fed ensilage instead of dried fodder-corn. For each thousand pounds of live weight this second ration was as follows: —

	Fat.	Proteine.	Carbohydrates.
	Pound.	Pounds.	Pounds.
50 pounds of ensilage, containing .	.10	.64	7.34
3 pounds winter wheat bran, containing	.10	.40	1.38
30 pounds brewers' grains, containing,	.40	1.58	3.00
Total digestible food . . .	.60	2.62	11.72

The digestibility of the ensilage is here assumed to be the same as green corn.

This ensilage-ration was fed to all four cows during the third period of twenty days.

The dried fodder-corn, as stated above, was cut and crushed in a machine, which leaves it in such a condition that cows can eat it easily. After the first day or two in the first period, the dried corn-ration was eaten without waste. During the second period, one of the cows seemed unable to eat all of the harder pieces of ensilage. The amount wasted, however, was regarded as too small to be taken into account. The facts, therefore, seem to show that dried fodder-corn, when cut and crushed, is eaten quite as readily, and with as little waste, as ensilage.

During the entire experiment the cows were milked twice daily, — at four A.M. and at four P.M. The milk of each cow was weighed separately, and its weight at once recorded.

Analyses of the milk were made on five consecutive days in each period. For this purpose sample No. 1 represented the total daily yield of cows I. and II., while sample No. 2 represented that of cows III. and IV. Results obtained when the cows were fed ensilage are for the sake of comparison printed in heavy type.

	I.	II.	III.	IV.
Calved . . .	Nov. 14, 1881.	Nov. 23, 1881.	Aug. 1, 1881.	Aug. 1, 1881.
Served . . .	Jan. 27, 1882.	Jan. 7, 1882.	Sept. 18, 1881.	Oct. 1, 1881.
Yield of milk during first period . .	Pounds. 624	Pounds. 540	Pounds. 339	Pounds. 350
Yield of milk during second period .	624	526	340	401
Yield of milk during third period . .	579	500	300	386
Total yield of each cow for 60 days .	1,827	1,566	979	1,137

In the following tables, cows I. and II. form herd No. 1; cows III. and IV., herd No. 2. The analytical results given below are *averages* drawn from the daily determinations of the milk of five consecutive days in each period.

	Herd No. 1.				
	Specific Gravity.	Total Solids.	Butter.	Proteine.	Sugar and Ash.
First period . . .	10,340	13.55	4.27	3.31	5.87
Second period . .	10,327	13.55	4.49	3.11	5.95
Third period . . .	10,330	13.87	4.58	3.20	6.09

	Herd No. 2.				
	Specific Gravity.	Total Solids.	Butter.	Proteine.	Sugar and Ash.
First period . . .	10,340	13.87	4.27	3.43	6.17
Second period . .	10,343	14.01	4.42	3.41	6.18
Third period . . .	10,346	14.51	4.53	3.59	6.39

As cows advance in their periods of lactation, the per cent of solid matter in their milk gradually increases, while the yield of milk, as is well known, decreases. A second table is therefore given, in which the absolute amounts of butter, proteine, etc., yielded by each herd during each period, are compared.

	Total Solids.		Butter.	
	Herd No. 1.	Herd No. 2.	Herd No. 1.	Herd No. 2.
	Pounds.	Pounds.	Pounds.	Pounds.
Total weight yielded during first period	157.7	95.5	49.7	29.4
Total weight yielded during second period	155.8	103.8	51.6	32.7
Total weight yielded during third period	149.6	99.5	49.4	31.0

	Proteine.		Sugar and Ash.	
	Herd No. 1.	Herd No. 2.	Herd No. 1.	Herd No. 2.
	Pounds.	Pounds.	Pounds.	Pounds.
Total weight yielded during first period	38.5	23.6	68.3	42.5
Total weight yielded during second period	35.8	25.2	68.4	45.8
Total weight yielded during third period	34.2	24.6	65.7	43.8

A summary of the facts shown in the above experiment is as follows: —

First, When the green corn was dried in stacks, the loss of food was less than it was when the corn was packed in a silo.

Second, When dried corn-fodder was cut and crushed, it was eaten by the cows under experiment quite as readily, and with as little waste, as ensilage.

Third, In three cases the yield of milk was not increased when ensilage was substituted for dried corn; but, in one case, ensilage caused an increase of eighty-seven pounds of milk in forty days.

Fourth, In the mixed milk for twenty days of herd No. 1, ensilage caused no increase in the yield of total solid matter: while in the milk of herd No. 2, for the same period, it caused a gain of eight pounds and one-third, or seven per cent.

GEO. H. COOK, *Director*.

NEW BRUNSWICK, N.J., Feb. 20, 1882.

Other experiments of the New-Jersey station prove that fodders (such as clover, hay, and wheat-straw) and foods (such as brewers' grains or roots made into rations containing the same amount of digestible material as rations of ensilage) are comparatively of the same value, both to sustain animals, and produce milk. Experiments in this direction lead the director of the station to publish this result: "Ensilage can produce no more milk than any other fodder which contains an equal amount of food." If this ensilage is merely a substitute, its value to us is to be determined by its relative cost. Experiment, and the practical judgment of our farmers, will determine this question after another season.

The discussion of these questions has been of incalculable value. Never before has there been so thorough an appreciation of the maize-plant as now. The value of dried corn fodder, hitherto but little understood by the large number of farmers, has been made apparent by the experiments of men on all sides, and spread far and wide by means of the institutes and farmers' clubs. Other fodders (millet, rye, oat-straw), when fed with the same or a less amount of nitrogenous food than is usually fed with ensilage, have given very valuable results. It is found that an acre of good soil, kept active, well worked, and fertilized for each crop, instead of lying idle for three-fourths of the year, may, by close succession of crops, as winter rye (cut for hay), millet, corn-fodder, or barley in summer and fall succession, produce enough to carry a much greater number of cattle than we have done in the past.

Our experience in this important matter should convince all of the necessity of a thoroughly equipped experiment station. It is not to our credit that we are compelled to look to the experiments of distant States.

PASTURES.

A large portion of the land of the Commonwealth is held as pasture. In a crowded community of manufacturing districts, and many populous cities, we reserve wide stretches of upland, over which cows wander for a few months in the year, and from which the farmer possibly imagines that he derives a profit.

These pastures are the constant topic of agricultural dis-

cussion. "How to improve the fertility of our pastures," is a standing question of clubs and institutes, only answered in theory.

The original fertility of the soil has been for generations sent into the towns in the diurnal milk-can, and the poor savings of the business put into the banks of deposit to be loaned to those who build up towns, or used to construct railroads that bring butter from Iowa to Boston, cheaper than it can be carried thither from Worcester or Franklin. Meanwhile, the moss-grown pasture, robbed of fertility, grows up to a tangled maze of bushes.

Briers, spoon-wood, hardhack, wood-waxen huckleberry, and similar usurpers take the place of grasses: hence the constantly recurring question of improvement.

In other countries pastures are not exclusively used for neat-stock and horses. In Europe and the British Islands sheep and hogs are pastured; and these animals maintain a high degree of fertility at the same time that a profitable husbandry is carried on.

We are not accustomed to pasture pigs; and many would, without thought, deny that the pig is a grazing animal. Pigs can be very profitably grown in pasture; and when herds of them are kept in small compass, and fed with grain, wonderful results in the way of fertilization can be achieved upon worn-out soils.

Sheep-husbandry is a sure means of restoring and maintaining fertility; but the present relation of sheep and dogs renders it useless for our benefit.

If the matter is brought to the cold light of figures, it would probably appear that the greater part of our pasture-land is really not worth renovating. Much of it is poor, stony, and distant. Fencing is a great expense. The land is in use only three or four months in the year. Our best arable fields are not well tilled; the fault of our farming being in spreading over a wide expanse of land, instead of concentrating labor upon fewer acres. Progressive farmers incline less to pastures, and more to cultivation. Instead of wandering over barren tracts of inhospitable pasture, their cows are kept in convenient yards at home, and fed from green crops raised, in rotation, upon land that is never idle, and not run to waste. Important information in regard to this method of feeding will be found in subsequent pages.

STATISTICS OF AGRICULTURE.

I am enabled by the assistance of Mr. Carroll D. Wright, chief of the Bureau of Labor Statistics, to give the results of the United-States census, so far as they show the condition of agriculture in the Commonwealth.

These I compare in the following table with the United-States census of 1870 and the State census of 1875, showing the condition and progress of our agriculture for ten years past. The State census of 1875 was the fifth census of the industrial statistics of the Commonwealth, and was taken with great thoroughness. It shows that the total domestic and agricultural product of the farms of Massachusetts for that year was $41,521,799. The total value of farm property was $209,974,877. The figures given from the hitherto unpublished statistics of the United-States census of 1880 deal only with property, products, and labor on farms, and do not include horses, cows, or products otherwise kept or produced. Judging from the figures given, our census of 1885 will record a gratifying increase; and it will appear that our agriculture not only holds its position, but makes a relative advance with the other industries of the Commonwealth.

	1870.	1875.	1880.
Horses	41,039	53,218	59,629
Working oxen	24,430	16,308	14,571
Milch cows	114,771	126,034	150,435
Other cattle	79,851	81,916	96,045
Sheep	78,560	58,773	67,979
Swine	49,178	42,255	80,123
Barley	123,071	46,884	80,128
Buckwheat	58,049	52,127	67,117
Oats	797,664	457,710	645,159
Wheat	34,644	13,749	15,768
Rye	239,227	250,113	213,716
Eggs (doz.)	–	3,446,530	6,754,179
Tobacco	7,312,885	5,993,666	5,369,436
Hay	597,455	671,130	684,679
Milk (gals.)	15,284,057	35,698,150*	29,662,953
Butter	6,559,161	7,922,431	9,655,587
Cheese	2,245,873	1,280,234	829,528
Corn	1,397,807	1,040,290	1,797,768
Potatoes	3,025,446	3,630,546	3,070,389

* These figures show the total production of milk, not only what was sold, but the quantity used in the manufacture of butter and cheese. The figures in the other columns indicate only the number of gallons actually sent to market.

PUBLIC MEETING OF THE BOARD

AT BRIDGEWATER.

THE country meeting of the Board for 1881 was held at the town-hall in Bridgewater on the 6th, 7th, and 8th of December. Mr. JOHN LANE of East Bridgewater, president of the Plymouth County Agricultural Society, called the meeting to order on Tuesday, Dec. 6, at ten o'clock. He said, —

In behalf of the Plymouth County Agricultural Society, I bid the State Board welcome to this town. Also the West Bridgewater Farmers' Club bid you all welcome. The inhabitants of East Bridgewater, where I reside, also bid you welcome.

I will now introduce to you Dr. L. G. LOWE of Bridgewater, who will deliver the opening address.

OPENING ADDRESS.

BY DR. L. G. LOWE.

GENTLEMEN OF THE STATE BOARD OF AGRICULTURE, AND FARMERS OF MASSACHUSETTS, — We bid you a hearty welcome to the old town of Bridgewater.

Although as regards age and reputation it cannot be compared to that venerable town in the eastern part of the county which was settled in 1620, and to which our State and our Nation are so much indebted for their growth and prosperity, Bridgewater can justly claim to be the oldest interior settlement in Plymouth County.

It was originally a plantation belonging to Duxbury, having been purchased as such, in the year 1649, of the sachem Ousnamequi, for the following consideration: viz., seven coats (a yard and a half in a coat), nine hatchets, eight hoes, twenty knives, four moose, and ten yards and a half of cotton.

This plantation was incorporated as a distinct town in the year 1656. As incorporated, the territory included, with some slight variation in boundaries, the area now covered by Brockton (formerly North Bridgewater), East Bridgewater,

West Bridgewater, and our own town, which was then known as the South Parish. One after another the North, the East, and finally the West Parishes withdrew from the parent town, leaving the South Parish in the possession of the name and the records of the old mother of them all. Pardon us if we feel a little proud of the name, and of claiming so many prosperous children, one of whom has outstripped her parent, and indeed all the towns of the county, and has reached the dignity of a city, — the only township in the county entitled to that honor.

As you are now favoring our town with a visit, you may be disposed to learn from us, before you try to enlighten us with the wisdom here assembled, what we have to say for ourselves. We shall begin our story by boasting a little. We claim to have the best agricultural grounds and buildings in the State; and, if the New-England Agricultural Society were not apparently permanently wedded to Worcester County, we should be tempted to try to induce her to look with favor on our enclosure over yonder river. But if any one dare dispute the superiority of our grounds, or of our venerable society (the oldest but one in the State), we defy any man from any part of the Commonwealth to dare to deny that we have the best agricultural president in the whole State. We only regret that his white locks remind us that we cannot have him always.

So anxious are we to make the most of him while we have him in office, that, with the aid of his own town and of the county, we have actually cut down yonder great hill lying between us and his homestead in East Bridgewater, that we may the more easily avail ourselves of his well-known hospitality, and feast our eyes on his fertile fields and his well-fed favorite Jerseys.

Our county society was formed in 1819; and it is a remarkable fact, worthy of mention, that one of our oldest and most interested members, Mr. George W. Wood of Middleborough, has attended every one of its exhibitions.

Besides the agricultural grounds, our town presents other attractions. The normal school, established here by the State because of the liberal contributions of our citizens for that object, is an institution of which we feel that we have reasons to be proud. It has been located here so long (since

1840), that it has become fully identified with us. A large proportion of the teachers in the county are graduates of this school; and lights from this centre are shining all through the length of our land, from Maine to California. It numbers at the present time about one hundred and seventy-five students. Its educational advantages have attracted many to our town as a place of residence. If any attending this meeting desire to visit this institution, they will be most heartily welcomed there by the principal and his assistants.

There is also within the limits of our town (about four miles distant from here) another State institution of a different description; but we regard it as a model of its kind, and important to us in its relations to agriculture. It presents one of the best illustrations of the capacities of Plymouth-county soil under proper care and culture. Many of us can remember when the farm of the State workhouse consisted mainly of wild woodland and pasturage.

Under the wise management of the former superintendent, supplemented by the judicious labors of his competent and efficient successor, the present incumbent, it is not surpassed, in the amount of the product it yields, by any farm of equal size, at least in this section of the State.

There are two manufacturing establishments within our town, to which we ought to allude in passing. One of these, our extensive iron-works, is situated about a mile north from this hall, on the right of the railway, as we enter town from Boston. This is an old corporation, with a large capital, and employing about five hundred hands. They have the machinery and conveniences here for doing the heaviest work, both in wrought and in cast iron. They have this year manufactured and sent to Norfolk, Va., an immense cotton-press, having more than double the capacity of any such press previously constructed. Its entire weight is two hundred and eighty-five tons. One of the castings alone weighed fifty-six thousand pounds. It is about sixty-six feet in height, and its capacity for pressure is six thousand tons on a bale of cotton. In wrought iron almost every thing is hammered out here, from the heaviest steamboat shaft, weighing forty-six tons, down to the little nail which fastens that shoe which our worthy Secretary Russell so utterly detests on to that noble animal which he so ardently admires.

Our other principal manufacturing establishment is the cotton-gin factory. Gins have been made in this place and in the adjoining town of East Bridgewater for many years; and as their manufacture in this State has been confined chiefly to this immediate vicinity, a brief history of the origin of this enterprise may be interesting.

About seventy-five years ago Mr. Eleazer Carver, one of our townsmen (now deceased), when a young man, started for the West and South on a tour of inspection, and in pursuit of employment at his trade as millwright. He sailed down the Ohio and the Mississippi alone in a skiff. It is said that on his way down the Ohio he stopped at a village on its right bank, where the city of Cincinnati now stands, to purchase provisions, and procured all the pork that town then afforded in laying in the small stock required for his use. After spending some years at the South in repairing cotton-gins, and subsequently in building some of these machines, he returned home, and formed a stock-company for their manufacture, of which company our universally esteemed venerable townsman, the Hon. Artemas Hale, was chosen the agent. Mr. Hale is now in his ninety-ninth year. He is the oldest ex-member of Congress living. He is in good health, and I trust will honor us with his presence at this meeting. Our town is deeply indebted to him for much of its prosperity and attractiveness. Some years ago a passenger on the railroad, having the building a little way west of the station here pointed out to him as a cotton-gin factory, innocently remarked that he had often heard that old boots, and various other miscellaneous and heterogeneous things, were used in the manufacture of the "critter," but he never before knew that gin could be extracted from cotton. Happy would it be for our community if no stronger beverage were used than that which could be drawn from the cotton-boll.

Our town is generally regarded as quite conservative. It may be superfluous to add, after what has been said, that we have sometimes heard it hinted that we are slightly self-conceited. So slow are we in our movements, that we have received the romantic appellation of "Sleepy Hollow" (not, however, because of our schoolmasters manufactured in yonder hall). It is generally acknowledged, however, that, when we do get waked up, we move all together, and in earnest.

Until comparatively recently, no active measures have been taken to commemorate the services of those who went from our town during the late Rebellion, and sacrificed their lives in the defence of their country. After most other towns had erected suitable structures for this praiseworthy object, instigated by zeal and earnest efforts of a very few who took an active interest in this matter, we decided to follow the example set in other places, and are now, through the liberality of friends, and especial appropriations by the town, constructing a substantial memorial hall and library building combined. The structure is of brick and stone, of the Queen Anne style of architecture, and is only a few rods from this hall.

But you may say that you have come here in the interest of agriculture, and would like to have us keep that fact in mind, and tell you something about the nature of the soil in Plymouth County, the crops raised, and our system of husbandry, — in a word, "what we know about farming."

As you are probably well aware, agriculture is not the leading industry in the Old Colony, the soil not being so rich by nature as in most other parts of the State; but, notwithstanding this drawback, our comparatively sterile soil has some redeeming qualities. It is for the most part level, and but slightly encumbered with stones, large or small: thus it is admirably adapted for the use of machines.

If the city of Boston, instead of trying at an enormous expense to rid themselves of their waste material by washing it from the face of the earth, and depositing it by the island of the *moon*, could only discover some practical way of condensing it, and forwarding it to us, old Mother-Earth would soon become so fresh and fair that she would not know herself when she looked in the glass, and the genial president of our society would not have his quiet dreams disturbed, like Hamlet's, by that ever rising ghost, our eight-thousand-dollar debt.

While it is a common saying in Plymouth County that "farming doesn't pay," some of our citizens are demonstrating practically that *they*, at least, can get a comfortable living from the soil. They do not aim at becoming Astors or Vanderbilts; but they love their calling, and are willing to forego the so-called luxuries and the superfluities of life for

the simple but no less substantial enjoyments and blessings which honest toil in the fresh air and bright sunlight secure to those who love to sow in the spring, and to gather the golden harvests in the fall. Their sleep is sweet, and they have but little fear of blackmailers or assassins. There are farmers in the Old Colony, who, I believe, enjoy as much solid comfort to the square inch as any master mechanic, merchant prince, Wall-street broker, or bloated bondholder.

The soil of our county is quite diversified; varying from sandy upland, which is left to the growth of forest-trees, mostly pine, oak, birch, and maple, — through sandy loam, which, with sufficient enriching, yields good crops of rye, oats, Indian corn, and potatoes, — down to meadow-muck, which, when well drained and properly cared for, yields excellent crops of Timothy and red-top. The Hon. Velorous Taft, who was present as State delegate at our last exhibition, told us that Indian corn can be raised east of the Connecticut River at a less cost than it can be obtained from the West. If he is right, we can safely advise our farmers in this section to grow corn; for I believe it is a fact, that as large yields of this cereal have been obtained here as in any part of the State. The writer of this has land on his farm where upwards of one hundred bushels to the acre have been raised; but it was when it belonged to a former owner, and a better farmer than the present possessor of the field can ever hope to be.

Root-crops are raised among us to a considerable extent, and some of our farmers have ventured a little in the sugar-beet direction; but I believe the majority of these have about concluded, that, so far as the actual profit to the raiser is concerned, it would be about as well to try to squeeze blood from a turnip as to extract sugar from the beet advantageously at present prices. Our president raises a variety (*Lane's* Imperial, we presume), which, however, he feeds to his stock, not believing it profitable to have their liquid sweetness drawn out by the Franklin Company. If these remarks happen to provoke a discussion here on the sugar-beet question, it will only tend to throw more light on this saccharine subject.

President Lane would have us sow wheat, and he thinks every farmer should be fined who does not raise at least an

acre of that grain every year; but most of them think our soil is not well adapted to its culture.

Some of the farmers in this section make a specialty of garden vegetables; others, of small fruits. Many varieties of the latter, as strawberries and blackberries, find a very genial soil in Plymouth and Bristol counties. Of the larger fruits, pears do admirably, and apples fairly, if we have patience to fight the canker-worms and the borers. Peaches grew in perfection thirty years ago; since then they have been stricken with the yellows, and have ceased to mature their fruit. Of late years they seem to be improving, so that we have hopes that this delicious and healthy fruit may again be added to our list.

If you inquire what is the relative condition of agriculture in the county as compared with a quarter of a century ago, we reply unhesitatingly that it has improved. As evidence of this, we cite the fact, that, instead of one agricultural society, we now have five, located in different sections of the county, and holding exhibitions regularly every fall; and notwithstanding the fact that the parent society has given birth to several healthy children, she is still in the prime of life, and able and willing to labor diligently for the good of all. Some persons are disposed to criticise her because she does not accomplish more; but when we reflect, that for years she has distributed more in premiums than any county society in the State save one, and has within the last twenty years greatly enlarged and improved both her grounds and her buildings, and this very year added a grand stand at an expense of over three thousand dollars, more than one-half of which was defrayed by private subscription, it does not look as though our mother-society were quite yet on her last legs. To be sure, some years ago we greatly enlarged our main building, and then added a piazza, a cupola, and another ornament in the shape of a good-sized mortgage (which last embellishment has been a great bugbear to many); but all this need not discourage us. Since that debt was incurred, we have expended four thousand dollars for additional buildings required, and at the same time have reduced our obligations from thirteen thousand dollars down to eight thousand dollars. And what have we to show for this debt? Large and substantial buildings, all in good repair,

and sixty-five acres of land admirably adapted to our use. We are not lost in the woods yet. Under the guidance of our gallant leader, who knows no such word as *fail*, we are gradually bettering our condition; and if all those who complain will only help us with their heads and their pockets, the debt will soon become so small as to cause no one any uneasiness.

Besides these societies, we have now quite a number of farmers' clubs in the county, one of which, and I believe the oldest, celebrated its tenth anniversary last evening, having held its meetings regularly every winter since its organization. Farmers' institutes are held also several times a year by a number of the societies; and our honorable secretary tells us that none which he has visited in the State have surpassed those he has attended in this county, under the auspices of the old society. It ought to be mentioned in this connection (that both sides of this question may be heard), that it is said to be a fact, that more land is given up to wood in this county than twenty-five years ago. This may be so; but I think it safe to say, that the acres *cultivated* receive more attention than formerly, and that the additional woodland consists mainly of poor pastures better adapted to wood than to feed. For the lack of good pasturing, many of our farmers are in the habit of soiling their cattle, either wholly or in part. If the ensilage system which some in the county have adopted — none, however, in this town as yet — comes into general use, still more of our poor pastures will be given up to wood. We expect to learn more about the silo before this meeting is over.

Both our ploughed land and our grass-fields are enriched more liberally than formerly. The use of the special or commercial fertilizers has grown up here almost entirely within the last quarter of a century. The farmer who does not employ these at all is now the exception.

Another evidence of the advance of the farming interests is the improvement in stock in this section. To our neighbor East Bridgewater belongs the honor of the introduction of Jersey cattle into the county. In 1854 Mr. Seth Bryant, who until recently lived in that town, imported a Jersey cow with her calf. In the following year Hon. Aaron Hobart of the same town imported two cows and a bull of

the same breed. From these two importations were derived a great proportion of the improved stock in Plymouth County. There was for a time quite an opposition to this breed on the part of the farmers: but in 1865 there were at least nineteen Jersey bulls in the county; and now every farmer is proud of having, at least, some Jersey blood in his herd.

In June last Mr. Warren A. Howard of Brockton purchased six heifers and a bull of the Holstein breed. What effect this may have on our future stock we cannot foretell.

We ought not to close without alluding to an enterprise, started a few years ago among farmers in this county, for disposing of their milk in Boston.

In the fall of 1877 a company was formed, under the title of the "Old Colony Milk Producers' Association," for the purpose of forwarding their milk to Boston by rail, in care of a messenger employed by them to take charge of it on the train, and to dispose of it in the city. Their aim has been to supply the consumers directly from the farm, without the intervention of either contractors or peddlers. As yet, however, they are selling mostly to the peddlers.

This is the pioneer movement in this direction in the State, and as such deserves the encouragement of all interested in benefiting the condition of the farmer.

The nearer it is practicable for the producer to get to the consumer, the more of the profits will reach the pocket of the former, and, I think we may safely add (so far as milk is concerned, at least), the better it will be for the consumer. This company has fought its way against opposition and discouragements of various kinds, until, at the present time, it is unable to supply the demands made for milk, and is desirous of increasing its membership and the number of its cans. Great credit is due to the officers of this association, who have devoted much time and attention gratuitously in establishing and sustaining this organization.

And now, gentlemen of the Board, in yielding the floor to you, let us close by thanking you for appointing this winter meeting in our town.

When our president invited you here, he was influenced by a somewhat selfish motive. Being a frank man, he freely confessed it. His hopes and expectations were, that by coming here you would help the cause of agriculture in

general in this region, while you would, indirectly at least, advance the interest of the Plymouth County Society in particular. If you accomplish the first object, as we know you will, the second will follow as certainly as the harvest does the seed-time; and whilst he who invited you will feel well repaid, the whole of Plymouth County, the home of our fathers, and so important a part of the right shoulder of our grand old Commonwealth, will receive lasting benefit from your few days' sojourn in the heart of the Old Colony.

The Chairman then introduced Dr. George Austin Bowen of Woodstock, Conn., who read the following lecture on

THE DIGESTION AND WINTER FEEDING OF DOMESTIC ANIMALS.

In presenting this paper to your consideration, I do not advance any new theories or methods of my own, but content myself with a brief survey of the subject, presenting only a few of the leading facts, and leave to you as intelligent farmers to elaborate them by your discussion.

To my mind this is a very practical question for New-England farmers to consider; for the old methods of farming, which were only allowable in a new country, are rapidly passing away. The accumulated fertility of centuries has been wasted by a few generations; and the question now comes imperatively to every thoughtful tiller of the soil, how to maintain his flocks and herds upon the lands despoiled by his fathers. Happily, science is ready to aid us in this matter, and is now developing the many questions pertaining to agriculture. The successful farmer of the future will be the scientific man, who will accept the facts presented, and who will know and be able to tell the reason why, for all that he does. The world grows in this direction; and we must keep pace with it, or lose our position. The man who simply throws an armful of hay three times a day before his stock, and considers himself the gainer by all that they do not eat, will be unable to successfully compete with his neighbor who selects those articles of food which he knows contain the greatest amount of nutriment at the least

cost, and feeds them to his stock in accordance with the known laws of digestion and assimilation.

In the demand for food the whole universe stands upon an equality, vegetable and animal life alike requiring it. The plant, however, differs from the animal in its power of retaining all the increase derived from its food, all received from both the soil and the atmosphere remaining permanently in its structure a component part of the whole, which is ever increasing in size (excepting in some of the higher forms which shed their leaves, blossoms, and seeds, when they have performed their functions). But in the animal economy a constant change is taking place, — decay and death in the midst of life. Where the most life and action exist, there will be found the greatest amount of decay. The animal soon attains its size; and the further supply of food is only necessary to repair the waste that is ever going on in the nervous tissues, and for the creation of heat. The waste of the system, however, is not equal in all. The deer, whose muscles move quickly, and whose nervous power is of the keenest order, has a far greater amount of waste than the slow and unenergetic bear, who passes a portion of the year (at least in northern latitudes) in hybernation; which act itself is an illustration of the rapidity of nutrition and waste; for in this condition there is no muscular motion further than a slow respiration and pulsation of the heart, and a feeble peristaltic action of the intestines, the accumulated fat of the warm season being fully sufficient for the maintenance of life during the most protracted winter.

The age of the animal has also much to do with the amount of food required; the young and growing requiring a far greater amount, in proportion to their size, than those who have reached maturity. Different periods of adult life also require varying amounts of food. As age advances, less is eaten than during the more active periods of life.

We all know that the size of plants can be augmented by increasing the food-supply: instances of such are familiar to all. The same rule holds good in the case of animals. The more food that can be digested, the larger and more thrifty the animal will be. But there is a fact beyond this even. The old saying, that every part eaten strengthens a like part does not hold good exactly: but it is a well-known fact

among scientists, that each part can be strengthened by appropriate feeding; thus, blood-corpuscles are promoted by the feeding of iron. Non-azotized or farinaceous food favors the formation of fats; and those rich in albuminoids or nitrogenous matters develop the bones, and give tone and quality to the muscles.

This development by special feeding is quite often instanced in the case of the honey-bee (*Apis mellifera*). If by any chance the hive is deprived of its queen, the bees choose a cell intended for a neuter, enlarge it somewhat by destroying those around it; and when the larvæ emerges, it is fed with what apiarists term royal jelly, — an aliment of a very stimulating nature, and quite different from the bee-bread intended for the workers. The neuter thus treated comes out a different creature from what was the original intention, for it becomes a true queen. The sexual organs are perfected, the proportionate length of the body and wings are changed, and also the shape of the sting, tongue, and jaws. The hollow in the thighs, in which the pollen is carried, has wholly disappeared; and the power to secrete wax has been lost. It is supposed that the greater part of this change has been brought about by feeding.

There are two prominent sources of demand for food, — the waste of the body, of which we have just spoken, and the maintenance of animal heat; for in all the higher animals and birds, and to a limited extent in insects, there is a process going on analogous to ordinary combustion. The carbon and hydrogen which are directly supplied by the food, or which have for the time been employed in the composition of the body, are set free by the union of oxygen obtained by respiration, and give off as much heat as though the same materials had been consumed by fire in a furnace.

It is perhaps proper to remark, that the evolution of heat is not confined to the animal kingdom alone: the higher orders of plant-life show by many curious experiments that they possess it to an eminent degree.

The temperatures of mammalia ranges from 90° to 104°, although higher temperatures are sometimes found; and, singularly enough, those animals inhabiting the coldest regions have shown it to the greatest degree, the arctic fox having been found to give a temperature of 107° when

the thermometer showed that of the surrounding air to be 14°. The temperature of the human body is usually placed at 98°; although parts of it are higher, the blood sometimes reaching 101½°.

The classification and composition of food would be an interesting question to consider, for chemistry has done much to point out the most economical methods of feeding for the production of muscular tissue, fat, or milk; but the question is a long one, — too long for an article like this. Nothing seems easier than that an analysis of the various animal products should be made, and of the proper food, so that, having a knowledge of both, we can supply the one to form the other; but in actual use the elaborately prepared tables of the chemist do not meet all the requirements of the case, owing to the many different ways these agents act upon each other, or the power all elementary bodies have of assuming active or passive conditions, — a state which the chemist calls allotropism.

But all food, to a certain degree, can be classified; four divisions generally being recognized, —

First, Carbohydrates, or compounds which unite carbon with oxygen, such as sugar and starch.

Second, Hydrocarbons; that is, unoxidized hydrogen compounds, as oils, fats, etc.

Third, Albuminoid bodies, or those that contain nitrogen. To this class belong albumen, caseine, fibrine, etc.

Fourth, Salts, of which the chloride of sodium (common salt) and phosphate of lime are examples.

Foods are sometimes called nitrogenized or tissue-making, or non-nitrogenized or heat-making.

I know of but one article of food that is perfect in its composition for the uses required of it; and that only serves its purpose for a limited period of the animal's life. I refer, of course, to milk, on which all our farm-stock depend for a vigorous start in life. In examining its composition, we can find many suggestions that we can advantageously carry out in our young and growing animals after they have passed the nursing period of life, and begin to receive their food from man.

The composition of milk is as follows, although each sample will vary somewhat: —

Water	873
Caseine	48
Sugar of milk	44
Butter	30
Phosphate of lime	2.30
Other salts	2.70
Total	1,000.00

Nearly nine-tenths is water. Why so undue a proportion? Simply that the necessities of the system may be carried out. These are to remove the solid effete materials of the body in a state of solution, — the production of cold by evaporation thus regulating the temperature of the system, — and to give a due amount of fluidity to the blood.

When we consider that two-thirds of the weight of the body is water, we will cease to wonder at the quantity that is contained, not only in this article, but in the majority of aliments. From this we would draw the inference, that one of the great requisites of the farm is a suitable and abundant supply of water. A good farmer told me a few weeks ago that he could never raise good pigs on very solid food; he wanted it made sloppy with water: and besides, he added with a knowing wink, "it is cheap and filling."

The article caseine represents the nitrogenous principle (the tissue-making), and forms the muscles (gelatinous and soft tissues) of the young animal, and supports those of the old as well. The chemist and the practical stockman agree in this; for the latter, who wishes to give good muscular development, feeds those materials rich in the albuminoids, such as bran, pease, brewer's grains, etc.

While speaking of caseine, it is proper to remark, that it presents nearly the same composition as albumen, showing that the young animal and the newly-hatched chick are nourished by the same food. Fibrine is also closely allied to caseine and albumen, and, when coagulated, may be changed into the latter by the addition of the nitrate of potash. The digestive juices also effect the same change in the stomach. It is also interesting to know, that during the incubation of eggs caseine is produced from albumen.

The third article, sugar of milk, is converted during the digestive process into lactic acid; and the butter, which follows next, is partially used for the production of heat, and partly

stored for future use in the form of fat. And here a word in regard to this: Of what use is fat in the system? It fills up all the vacant spaces, thus giving rotundity to the form, which is always pleasing to the eye; but it is of more utility than this, for it produces a high temperature by its oxidation. It aids digestion by metamorphosis; it aids the development of cell-life, as the nuclei of some cells are formed from it; and, as fat is such an excellent non-conductor of heat, it enables the body to economize its warmth. It also prevents friction from muscular action. Thus we see its use: but we cannot well obtain it, unless we feed those articles that largely contain it; and among these, and at the very head of the list, stands oil-cake, which is largely produced in this country; but the American farmer allows it to be taken from his very door, and transported to his English brother, who fully knows and appreciates its value.

The phosphate of lime is necessary for the development of the bones of the body, containing, as they do, 51.04 per cent of this substance; and 11.30 per cent are of the carbonate. Every farmer knows how necessary it is in the feed of his poultry; for, if this substance is defective, his hens will present him with soft-shell eggs. It is just as necessary in the young steer or heifer, and is not found to any great extent in their food or that of pigs: therefore a little fed to them occasionally will be eaten with evident relish.

The chief one of the other salts is the chloride of sodium, or common salt, which is of the most special importance in the animal economy, as by its decomposition it gives hydrochloric acid to the gastric juice, and soda to the bile and various salivary secretions, and is found in the blood in the form of phosphate of soda, which enables the plasma of the blood to hold carbonic acid in solution, and thus convey it to the lungs, freeing the body from a deadly poison. So we see that a regular and uniform quantity of salt is necessary for the maintenance of life; but it should also be observed, that it is not good economy to feed much of it to fattening animals, for the reason, that, when soda is deficient in the bile, the metamorphosis of albuminoid compounds can only yield fat and urea.

Having thus lightly touched upon the topic of food and its requirements, let us as briefly glance at the organs of

digestion, taking them in the regular order of their arrangement and action. Following the digestive tract, we find the teeth, mouth, œsophagus, stomach, small and large intestines, lacteals, thoracic duct, and the accessory glands. Each of these organs, when closely studied in regard to their anatomical structure and physiological action, fills us with ever increasing amazement; for they are more wonderful than any mechanism created by the hand of man. Indeed, the workings of nature indicate more clearly the existence of a divine Creator than all the dogmas of the whole religious world.

The teeth and mouth are so familiar to us that we will pass them by, and begin with the œsophagus, which is the passage connecting the mouth and the stomach: and its office is simply that of a canal to convey the food from one to the other. It is muscular in its structure, and is lined with a mucous surface, the same as the mouth.

In considering the stomach, it would be interesting to trace its development through all the forms of animal life, commencing with a cestoid entozoon, — like the tapeworm, which has no digestive tract, but whose whole surface seems to be a stomach of itself, absorbing by every part the nutritive juices in which it lives, — and carrying our observations through the various orders, in each discovering a more elaborate organ, till we come to that of the mammalia, who present the most complete of all, many of them being possessed of a compound stomach, or series of stomachs; and, as this is so intimately connected with our subject, we will the more closely study it, although compelled to pass over much that is interesting in regard to its anatomical structure.

The stomach of the horse is globular in its shape, is quite small in comparison to the size of the body, being size for size about half that of a man: that of the pig is very much like that of the horse; both of them might be called a simple stomach, as there is but one sack, or cavity. Cattle and sheep have a compound stomach; that is, a number of sacks, or cavities. The entire system of stomachs in the ruminant is divided into four compartments; the first being at the termination of the œsophagus, and termed the "rumen," "ventriculus," or "paunch." It is of great size, occupying nearly three-fourths of the abdominal cavity. The left side is elevated so high as to lie in contact with the left flank.

through which the trocar is passed in cases of hoven. The second stomach ("reticulum," or honeycomb stomach as it is called) has a very peculiar appearance in its interior, occasioned by the unequal folding of its mucous membrane. It is here that the singular provision of water-cells is found, which in the camel has been developed to an unusual degree, enabling it to go for many days without receiving a fresh supply of water. This is developed more or less in all the ruminants. The third stomach is called the "omasum," or many plies, from the peculiar manner in which the lining-membrane is disposed, which is much like the leaves of a book. This is in order to bring the food in contact with a large surface of the stomach. The fourth stomach is called the "abomasum," or reed. This is the seat of the final and true digestion, the gastric fluid being secreted from it alone. It is the lining portion of this stomach in the calf that furnishes rennet, which, from its containing an organic acid, possesses the power of coagulating milk, as illustrated in cheese-making.

The next division is the intestinal canal, which is divided into two portions, called the "small" and the "large intestines." Anatomists again subdivide each of these, but the present is enough for our purpose. The entire length of the intestinal canal in the horse is about ninety feet, or about ten times the length of his body; the small intestine occupying sixty-six feet, and the large twenty-four. That of the pig is sixteen times the length of the body, in the proportion of three to one as to large and small. The length in the ox is twenty-two times that of the body, and in the sheep twenty-seven times.

The lacteals are very minute vessels, which commence in the villi of the mucous surface of the small intestine, and pass to a series of small glands called the "mesenteric glands," and from these to more remote ones; growing fewer but larger every time, till they unite in a single one called the "thoracic duct," which is in the human subject about the size of a goose-quill, but grows smaller as its length increases, which is about eighteen or twenty inches. It lies just over the spinal column, and empties into the subclavian vein, one of the large veins within the shoulder and near the neck.

The accessory glands are the salivary glands of the mouth;

the liver, which is the largest gland of the body; the pancreas; and the spleen.

Having thus stated the organs of digestion, let us again commence in the same order, and inspect the digestive process itself, and see how the food that an animal eats becomes a portion of the living structure; first stating the general principals of digestion, and then mentioning the departures from that rule shown by the various animals of the farm.

The first process is the mastication of the food by the teeth. This reduces the bulk, breaks up its structure, and, with the aid of the tongue, mixes it with the saliva. The act of swallowing carries it to the stomach, where it is thoroughly mixed with the gastric juice, which is secreted from minute glands within the mucous lining. The peristaltic or grinding action of the muscles immediately commences, and materially aids the process. The action of the gastric fluid is purely a chemical one, dissolving the food, thus making its absorption an easy matter. Some articles also undergo a complete change by having their component parts altered by this fluid. The food when dissolved is about the consistency of cream, and is called "chyme." It passes into the small intestine, where it receives the bile from the liver, and the pancreatic fluid from the pancreas. By the action of these agents, it is converted into a fluid of a whitish color, called "chyle," and a residuum, which passes on to the large intestine, and is excreted from the system. As the contents of the intestine move downward, the chyle is taken up by the villi, or mouths of the lacteals, and is carried into the mesenteric glands, where some change is supposed to take place in it, but which is not thoroughly understood: from thence it flows directly into the blood through the thoracic duct. The true office of the spleen is not known. This, then, is the usual course of digestion, omitting some of the minute anatomical structure and glands, and their physiological action. Let us now glance at the departures, gaining, if we can, any practical points that will aid us in feeding our stock at a profit.

Digestion takes place in the horse in about the way that we have stated; but there is a peculiar anatomical structure and consequent physiological condition that belong to this animal, that is of deep pecuniary interest to us. The large

intestine of the horse is developed out of all proportion to the small; the colon, or head of it, being capable of holding four gallons of fluid. The stomach is comparatively small, as has been stated. The horse, as we know, will drink large quantities of water. This does not all remain in the stomach, but passes through the intestine into the colon: and here is the practical point; if water is given immediately or soon after feeding, the food, and especially grain, is carried with it, and out of the stomach, and beyond the point where it can be properly digested, and is voided with the excrement, the animal gaining but little benefit from it.

The simple form of digestion also takes place in swine; but in cattle, sheep, and ruminants generally, it is quite different. And here we see the wisdom of adapting them to their original position on the earth: for, having many enemies and but little means of defence, they must needs be expeditious in gathering their food; hence the large paunch was given them in which to store it, and also the power of returning it to the mouth for remastication, — "chewing the cud," as it is called.

The only process that takes place in the paunch is that of softening the food; it generally remaining from sixteen to eighteen hours before it is returned to the mouth, never less than fourteen, and sometimes thirty. When sufficiently softened, it passes into the second stomach, or reticulum, whose principal duty seems to be to roll the food into small balls, moistening it with water, and returning it to the mouth. Here it is remasticated, and some saliva added. When again swallowed, it does not go to the first or second stomach, but to the third, where it is more thoroughly macerated, or softened, and prepared for the true digestion, which takes place when it has slowly found its way into the fourth stomach, where the gastric fluid only is produced.

A fact should be mentioned here which has an important bearing upon the administration of medicine to ruminants. The œsophagus does not terminate in the first stomach, as in animals having a simple one, but is capable of being extended through the whole series. The food, whether solid or liquid, may sometimes (at the will of the animal, or under peculiar constitutional conditions) pass into the third or fourth stomach without a particle of it entering the first or

second. This explains why, in giving a medicine, it sometimes takes no effect; it probably having fallen into the paunch, instead of going to the end of the passage. Remedies should always be given in the liquid form, and be given very slowly: a ball would be sure to enter the paunch, and be useless. In the calf and lamb the first and second stomachs are of but little use, the food going to the true seat of digestion. In the mature animal, however, they are more directly utilized, as hay and rough fodder go to the first; water, to the second; and meal, only to the third, and even, in some instances, directly to the fourth.

The methods of feeding stock are of nearly as much practical importance in the results as the nature of the food itself. How often have we seen even as voracious animals as swine cloyed by too liberal feeding! and, when once cloyed, it is hard to bring them to an appetite again. The most profit is derived from stock that inherit strong, vigorous constitutions, and are kept growing, without any set-backs, till maturity, and then worked to the fullest capacity, even though it may somewhat shorten their period of usefulness. The animal must work in some way; and, when work ceases, expense commences.

Milch stock should be fed all that it will digest; and that is limited only by what they will hold. Give them time enough, and every particle in a well-filled paunch will be thoroughly digested. A period of rest should be allowed before calling the organs again into action by feeding.

Many, and I think the majority of stockmen, feed their swine and horses three times a day. As far as the horse is concerned, I think that this is the correct way; for his stomach is small, and, if fed less frequently, there is danger of its being too much distended. Its muscular action is prevented, the secretion of the gastric fluid retarded or suppressed, digestion is only partially performed, and the foundation for disease is received. But in the case of such a voracious creature as the hog, an animal that possesses the strongest of digestive organs, I think that his natural habit of eating about all the time might be so far considered as to feed him four times a day, and very young pigs at least five. But with regard to sheep and cattle the case is different: the enormous paunch will contain food enough to last a

much longer period; and twice a day, when well fed, will be sufficient. This is the manner that I would advise feeding, especially milch cows: Feed early in the morning with the poorest and coarsest fodder that you have to feed out; and while they are eating it the milking should be performed. As soon as they have finished it, another "foddering" of a better quality should be given, followed by a third, of the best hay. In feeding in this way the cows will be constantly eating, and will clean up all that is given them. As soon as the last feeding has been consumed, the mangers should be cleaned of any refuse left, and a feeding of roots given, to be followed by meal or bran. When the feeding is done, water immediately, seeing that each animal has its supply. A cow will drink more water after eating than she will after she has commenced to chew her cud. After drinking, she should be returned to her stall, or left to sun herself in a sheltered yard: she has then nothing more to do till afternoon, but will occupy her time in rest and sleep, or meditatively chew her cud. In the afternoon the feeding should commence at three o'clock, and proceed in the same manner as in the morning, with perhaps the omission of the roots. In feeding bran or meal, if more than two quarts a day are given, it is better to give it in two feedings than all at once, for it is apt to pack and not be thoroughly digested when a large quantity is passed into the stomach: or, better yet, mix it with cut hay or straw, the same as usually fed to horses; it will then be directed to the paunch, and in that case is sure to be digested, and the full benefit obtained.

There are many articles that have been underrated by the New-England farmer. He puts under his stock a great deal that had better go into them. He will feed a few cornstalks, but don't want many, as it is wasteful to feed them without cutting them up; and if cut up, the short, stiff pieces are apt to make their mouths sore. And as for chaff and straw, he declares that they are only fit for bedding; but analysis shows that these articles contain much of value if properly fed out. They would produce but poor returns if fed by themselves; but, combined with a few roots and a little oil-cake, they will carry cattle through the winter better than many farmers are able to do with the best of hay alone. I have been obliged to use these articles on my own farm, and have consequently seen their value.

The digestive capacity of the various ruminants seems to be about the same; that is, they will extract the same amount of nourishment from a given quantity. But the horse will digest less than any of them. All stock will digest about the same proportion from a large ration as a small one: hence we see that we can crowd our stock to greater efforts than the majority of us are doing. But there is a varying capacity for digestion in the different breeds of cattle and swine, as well as in the individuals of the breed. Illustrations are unnecessary, as all acquainted with stock are familiar with this; but it rarely enters the minds of farmers, that they can increase or ruin the digestion of their cattle by improper and irregular feeding. Much of the success of the dairy depends upon this.

I believe that all farmers should raise their own stock, and should have in view from the beginning, that, whether it is destined for work, beef, or milk, the whole profit of the animal comes from its powers of digestion. To this end the calf should be allowed to suckle its dam until able to eat hay and grain. This is better than teaching them to drink, even though new milk is given them; for the act of suckling promotes the flow of saliva, and the milk is more perfectly digested, the animal is more thrifty, and the foundation for future usefulness is laid.

I have had no experience in steaming food, except upon a very limited and primitive plan; but, judging from all that I can learn, it has not met with the success that was claimed for it a few years ago. It does not increase the digestibility of the food, but softens it, thereby relieving the digestive organs from a portion of the tax placed upon them, and enables the farmer to feed out a great deal of fodder that would otherwise be unpalatable to them.

As a curiosity of winter feeding, I would call your attention to the extensive experiments of Linus W. Miller of Stockton, N.Y., who for a number of years carried a herd of dry cows through the winter on a ration of three quarts of meal each per day: no hay whatsoever was given. Under this treatment the animal loses the large paunch, because of its non-distension. She drinks but little water, and does not chew her cud. He claims that they come out in the spring as well as those cows that have full rations of hay.

drop as fine-looking and healthy calves, assume the eating of hay again without inconvenience, and, in fact, that it is the best way to treat them.

Too much cannot be said in regard to the regularity of feeding. It is one-half the battle. Consider the condition that we ourselves would be in, if we ate at any period of the day that was convenient. Our cattle and horses are as much creatures of habit as we are; and trespassing upon that habit will produce the same results as in ourselves.

The old saying, that too many cooks spoil the broth applies to the stable as well as to the kitchen. The feeding should always be done by one person, who will soon learn what each animal will consume; and none will be under or over fed. Salt will be administered regularly; they will not be uneasy or expectant when others are around; and, if any thing is wrong with them, you know just where to place the blame. Give your cattle good care, and they will amply repay you. Feed regularly, and feed well. Let the breed be what it may, this applies to all. The wealth of the New-England farmer to-day lies in his stock and their products; and this wealth should be as zealously guarded and cared for as any stock that is quoted on the exchange.

The CHAIRMAN. The subject is now open for discussion.

J. B. HADWEN (of Worcester). I fully agree with what has been said by the essayist, as far as I am able to judge from my own experience. Of course, he has told us many things which we have no opportunity of proving by experience. He has given us a good deal of information in relation to the internal organization of the animal; and the points he has made in regard to regularity of feeding, I think, have great force. In feeding my own cattle, I consider regularity of feeding of the first importance. I am a great believer in nutritious food, feeding the best of every thing which is known to be good; and it is only by uniform care in feeding, and supplying a uniform quality of food, that the best results can be obtained. It is these conditions that the breeder has to maintain, if he expects to improve his strain of cattle. It makes no difference what the breed is: unless they are regularly cared for, and kept under the same good conditions, they will deteriorate.

I will briefly allude to the feeding of calves. It is well known, especially among milkmen, that a calf does not always have the amount of milk that it would best thrive on: it is necessary to substitute something to save the milk. The only substitute that I have ever tried for milk, in such a case, is hay-tea; and hay-tea, to be good, as the doctor has said, must contain a little milk. You can, however, carry a calf along with two quarts of milk a day, if the tea is made of good material. I have done that repeatedly; but I would rather have three quarts, and would be a little better pleased with four. Four quarts of milk a day will carry a calf along in a very fair condition. It is better, however, to let the calf suck for several weeks, as the doctor has told us, that the food may be mixed with the saliva; and the calf will thrive better. But it is frequently the case, especially with the men who are selling milk, the demands of whose customers are imperative, that the calf must be pinched; and in that case it can be carried along in the way I have suggested.

Mr. SLADE. Will you tell us how to make hay-tea?

Mr. HADWEN. Hay-tea should be made of the very best hay, — early hay, cut when the grass is in its most succulent condition.

Mr. SLADE. Would you take rowen?

Mr. HADWEN. I would rather have the early-cut hay, not so much cured as rowen should be. The simplest way to make the tea is this: Suppose you want to make tea for the calf to-morrow morning. You take the hay to-night, and turn upon it a sufficient quantity of boiling water to extract its nutriment. That should remain in the vessel until the next morning. Then you may warm it, or add warm milk to it, enough to bring it up to the temperature suitable for the calf, which is perhaps a little more than ninety degrees. The tea should be made in the morning for feeding at night, in order to give sufficient time for the water to extract the nutritive qualities of the hay. That is about the whole of it, as far as our practice is concerned; and we have practised feeding hay-tea for a good many years.

I have always noticed that milkmen's calves are not quite as good as some others; that is, they are not show calves. They are never suitable to exhibit for premiums; but when they are one, two, or more years old, they come up as well as

any. There is one advantage in moderate feeding in the early life of a calf, — you do not make that strong, bony, and coarse animal that you do when you allow it to have all the milk that it will take. I would rather run my risk to raise a calf with moderate feeding than to give more than a sufficient amount of food to make a good and symmetrical animal.

The CHAIRMAN. I would like to ask Mr. Hadwen if he ever finds any difficulty in allowing his Jersey calves to suck.

Mr. HADWEN. As a rule, a Jersey calf does not thrive on the milk of its mother: it seems to be too rich for the calf, and soon the digestive organs are out of condition. I have found that it is a safer way to wean the calf when a few days old. I never give my calves new milk more than a few weeks, and then perhaps it must be diluted with water. It is an unsafe thing, as a rule, to allow a Jersey calf to suck its dam.

The CHAIRMAN. That is, I think, something that most people do not understand. I have lost some of my best calves by letting them suck.

Mr. E. F. BOWDITCH (of Framingham). If you will allow me, I will add a little to what Mr. Hadwen has said about raising a Jersey calf on its mother. If you want to do it, it can be done safely by allowing the calf to have only a very small allowance. I have had occasion to try that. Instead of letting them have what they would naturally take (three or four quarts), if you keep them down to one-half of that, and then milk out the rest, which is supposed to be a little richer, you will obviate that difficulty. I believe that the natural way is always the best; and the nearer we can come to nature, the better.

I always raise my thoroughbred calves on common cows; and, by having a common cow which is a large milker, I can carry two calves on that cow for four months; and then I change off, and turn them out, and let them take care of themselves.

If you are obliged to feed by hand, the one great difficulty is in getting the right temperature, which should be above ninety degrees. Farmers, if they try the temperature, will find that they are feeding their milk too cold. Milk at eighty feels warm to cold fingers, and you think it is warm enough.

Before I tried raising my calves on wet-nurses, my attention was called to four or five valuable calves that were not growing, and were troubled with diarrhœa, which could not be stopped in the ordinary way. I inquired of the man who fed them if he was feeding at the same temperature as usual. He said he was. I found him on his way to feed the calves, and put my fingers into the pail. I said, "You are not feeding at the proper temperature." Although the milk felt quite warm, it proved to be at eighty, instead of ninety-five or ninety-six, as it should have been.

There is one difficulty which you obviate by bringing up your calves on wet-nurses. I suppose we are all troubled in the same way when we bring up on the pail, — that the calves suck each other's tails and ears, and make them selves very disagreeable, and disfigure themselves; and in cold weather, by wetting the calf's ears, you are very likely to have that part frozen, and may lose it, as has happened to me. There is no way of stopping that, that I know of, absolutely; but bringing the calf up on a wet-nurse is a great help. Of course, the reason that a calf sucks is, that the milk has not been properly mixed with the saliva; the calf, being always hungry, drinks very fast, swallows it down, and digestion does not begin properly: the calf is in trouble, and must get hold of something, and try to get the saliva down to meet the milk, instead of having it go down with the milk, as nature intended. A little oil-meal, or, better still, perhaps, a piece of broken oil-cake, put into the calf's mouth as soon as he gets through drinking from the pail, will very often start the saliva, and the calf will amuse itself in that way, and let its companions' ears alone. If you try that a few times, the calf gets fond of the oil-meal, and will go on and feed himself, and you do not have to put it in his mouth.

Mr. PHILBRICK. Have you ever used oatmeal for feeding calves?

Mr. BOWDITCH. Yes, sir: I have always given my calves bruised oats, and I encourage them to eat all they can. I raise my calves on the principle that any thing that is worth doing at all is worth doing as well as you can. If you want to bring your children up well, you give them the most nutritious food you can think of; and the same rule holds good with regard to the raising of calves. I find, that, in raising

calves on wet-nurses, they will keep on sucking until the cow weans them: sometimes it may be ten months, and sometimes it may be eleven months. I have a calf now that is only three weeks old; and it begins to eat its bruised oats and a little oil-meal besides, — having a very good allowance of milk, — and also begins to eat a few roots, and will pick a little bit of hay.

Mr. RUSSELL. Do you find that the use of a wet-nurse leads to rapid growth and early development?

Mr. BOWDITCH. Yes, sir. I do not agree with Mr. Hadwen, that, if a Jersey calf is allowed to have all the milk it will take from a wet-nurse, it will cause the coarseness of bone that he suggested. I think that comes in the breed. A great many people say they do not want their dairy calves to be highly fed, because it will create a tendency to take on fat rather than to develop into the wedge shape, which is supposed to be the shape for a dairy cow. Now, in the tests that I have made with my own cows, in making butter, I find that a cow, when she comes into new milk in a high state of flesh, will give, perhaps, not more milk, but more cream, and will make more butter, and I think a better quality of butter, than she will when she comes in in thinner flesh.

QUESTION. What kind of hay is best for calves the first winter?

Mr. BOWDITCH. The nearer you can come to grass, the better, — the second crop, or very early-cut first crop. I think we are all tending to make our first crop very nearly equal to rowen. Most farmers, I think, would like to finish haying on the 4th of July, instead of beginning on the 5th, as we used to. I always try to finish on the 4th.

Dr. WAKEFIELD. We have had the philosophical and physiological discussion of this subject. Will Mr. Bowditch give us the practical, and tell us how we can winter feed so that a cow shall give as much and as good milk as when she is on grass?

Mr. BOWDITCH. The first thing is to have the proper material to do it with.

Mr. SESSIONS. It seem to me, that, although we may all agree with what Mr. Bowditch has said about the best way of raising calves, those of us who live in the country, and

make butter for a living, cannot afford wet-nursing: it costs too much. I would like to ask him if he has had any experience in feeding calves on skim-milk.

Mr. Bowditch. If you are short of pasture and short of fodder, of course you cannot use a wet-nurse; but, if you have plenty of pasture or fodder to feed a wet-nurse cow, I think you can raise a calf as cheaply, in dollars and cents, on a wet-nurse, — without taking into account the fact that your calf will be much better at a year old, — as you can do it by skim-milk.

Mr. Sessions. If you raise two calves on one cow, it will make the calves cost thirty dollars apiece at six months old; and they are not worth more than fifteen dollars in the market when they are a year old.

Mr. Bowditch. I feed my wet-nurse cows in winter on the poorest fodder I have, sometimes a pinch of grain, but very little.

Mr. Sessions. You don't approve, I take it, of feeding skim-milk at all to calves?

Mr. Bowditch. It has been done. I raise a good many calves on skim-milk.

Mr. Sessions. I want to get at something that is practicable for poor people, — for farmers who have not a great deal of capital.

Mr. Bowditch. The skim-milk should be, in the first place, perfectly sweet, and it should be fed with great regularity, — not too much, as it will be likely to distend the stomach; and, taking it as quickly as they do, they are uncomfortable, which leads them to suck each other's ears. One important point is, to be sure to get the temperature right. In New Hampshire and other parts of the country, where they raise oxen and premium steers, they can afford to put their calves on wet-nurses. They find that it pays them very well to do it.

Mr. Slade. In feeding calves on skim-milk, would you put in any cotton-seed meal?

Mr. Bowditch. I have put in oatmeal and linseed-meal. If the meal is put in properly, it does very well. Mr Thorne of Thorndale, the well-known shorthorn breeder. feeds linseed-meal to his calves. It is mixed with the milk, and does very well. If you feed new milk for ten days or a

fortnight, and then feed skim-milk, the calf's stomach will begin to digest dry grain. I think it is much better to feed it dry, because they use their saliva, and it helps them to digest the food better.

QUESTION. Would you give spring calves meal in the winter?

Mr. BOWDITCH. I think that we err more in giving them too little than we do in giving them too much. I think that for one calf that is over-fed there are hundreds that do not get enough.

QUESTION. How much meal is good for a calf?

Mr. BOWDITCH. If calves are well fed, I think, they are not inclined to over-eat. In my calves' pens I almost always find a little food left that they do not care to eat. I feed a mixture of bruised oats and oil-meal; and, if they would eat a little corn-meal with it, I would let them have it. But I think if you gave a calf all it would eat, it would not eat a pint a day, if it had plenty of other things.

QUESTION. Would not a calf that was dropped last spring eat more than that?

Mr. BOWDITCH. Yes, sir. A calf that was eight months old would eat more than that; but I do not think a quart of corn-meal would hurt a calf of that age, or a little more, possibly.

QUESTION. Many of our people feed large amounts of shorts and fine feed: would that be any better for a calf than Indian meal?

Mr. BOWDITCH. I think it would be. I think a mixture of the two would be better still. But I have often thought of what my friend Mr. Thorne said of linseed-meal, — that it was not only the best food, but it was the best medicine. I have never known an animal of any age to be hurt by linseed-meal in any quantity that it would eat.

QUESTION. If a calf is brought up on a cow to the age of three or four months, is there not danger of re-action when the calf is taken from the cow, and put on other food?

Mr. BOWDITCH. They will begin to eat when they have a wet-nurse by their side all the time quicker than they will if they are left alone. I did not mean to be understood that I take a calf off at three or four months old. When I put two calves on a new milch cow, she will give enough milk

for both for three months; and then I take one calf off and put it on another cow, and let the other calf have all the milk that the wet-nurse will give.

QUESTION. At what age would you wean a calf?

Mr. BOWDITCH. If I had the milk to spare, I would keep him on a wet-nurse as long as he wanted it. I had a pet bull-calf that had his belly full of skim-milk until he was thirteen or fourteen months old, and it seemed to do him good.

Mr. SESSIONS. New milk would seem to be the best thing that we can find to raise a calf on; but the question is, Can we afford to give it to him? It is well known that the majority of the calves of Massachusetts are ordinary cattle, that, at the age of a year, can be bought in the market for fifteen dollars. You can buy a thousand of yearling heifers at that price; and of course, the cattle of Massachusetts, as a whole, are made up of such stock. They are not thoroughbreds. You may say they ought to be worth more; but will any man say that people who farm for a living can raise calves on new milk, and sell them at that price and make a living? The men who make butter must have the cream from their milk to buy their wheat-flour, to buy their wives and daughters clothing; and they cannot afford to give their calves new milk. They would cost more at five or six months old than they would bring when they came in as cows.

Mr. BOWDITCH. What do you consider the value of sweet skim-milk for feeding purposes, — for pigs, for instance?

Mr. SESSIONS. I am not able to say. We use it for the production of calves to the best of our ability. I have never made an estimate of its value. We have no other way of using it, only to feed it out.

Mr. TAFT. Mr. Sessions lives up in the hills, ten miles from Springfield, in Hampden County.

Mr. SLADE. I presume no one knows better than Mr. Bowditch what skim-milk is worth; but the only way to get at that sort of thing is to put it down in dollars and cents.

Mr. BOWDITCH. I will take it at a cent a quart. How many months would you give your calf skim-milk?

Mr. SESSIONS. Just as long as I have the milk to spare.

Mr. BOWDITCH. You would feed it eight months, wouldn't you?

Mr. Sessions. If I had it to spare.

Mr. Bowditch. And you feed between eight and ten quarts a day?

Mr. Sessions. Yes, sir.

Mr. Bowditch. Eight months would be two hundred and forty days; and, estimating the quantity fed at ten quarts a day, it would make twenty-four hundred quarts of skim-milk, which, at one cent a quart, amounts to twenty-four dollars.

Mr. Sessions. That figures up very nicely. You might go up into Canada, and look at a white-pine tree, and say it will make so many thousand shingles, which will be worth a certain price; but if there is no market for the shingles when you get them, they are not worth any thing. Skim-milk is not worth a cent a quart with us: we cannot sell it for any thing.

Mr. Bowditch. If you cannot sell it, you can feed it to pigs, and make it worth more than a cent a quart.

Mr. Sessions. I don't know but I can, but I have some doubt about that. What I want to get at is, if there is not something that can be added to skim-milk that will make it nearly as good as new milk, so that farmers who are obliged to take the cream to make butter can use it to good advantage.

Mr. Bowditch. As I say, linseed-meal is the best thing I know of. Feed your skim-milk at the proper temperature (ninety-seven or ninety-eight degrees by the thermometer), and make your calf eat it as slowly as you can, and you will be sure to have a very satisfactory calf.

I agree with what the doctor said about feeding in every particular, except that he suggested giving one feed of rough fodder before he began milking in the morning. If he is in the habit of milking himself, I think he will find it rather uncomfortable. The cow will stretch around this way and that, and step forward and step back, and make the operation of milking a difficult one. I think in a state of nature a cow does not feed much before light. If you turn out a cow in summer or in fall feed, so that she can fill that large No. 1 stomach, she will do it; and then she will lie down and keep perfectly quiet for six or eight hours at least, until she has chewed that all over; and so, in feeding in the barn,

following that principle, I would feed nothing but the very best early-cut hay and rowen, — different kinds of hay, so as to tempt their appetite. If you have any particular kind of hay in the barn that they like less than another, feed that first. Feed in that way, a little at a time, so as to keep their appetites sharp. Keep them busily eating all the time, and, when you get through with the different qualities of hay, feed your roots, and then your meal; or, for convenience' sake (which seems to answer the same purpose equally well), feed your meal on top of the roots.

Dr. WAKEFIELD. If you were feeding to get the most milk, what grain would you feed? and when and how would you feed it?

Mr. BOWDITCH. I have always been a butter-maker: therefore I have never fed to get any great quantity of milk, although some of my cows will give over twenty quarts of milk a day. But my feed for making butter is no grain at all, except corn-meal. I have found, that, if I fed any other grain, my butter-merchant would tell me that I had been feeding something that was undesirable. I have had him reduce it to so fine a point, that, when one cow out of twenty was having five or six quarts of shorts a day, he informed me that I was feeding something I had better not continue.

Dr. WAKEFIED. Wouldn't you feed something else, if you were feeding to get the largest quantity of milk, to say nothing about making butter?

Mr. BOWDITCH. Yes, sir. I should feed shorts; but I don't pretend to know much about making milk.

Dr. WAKEFIELD. Will you tell us about making butter?

Mr. BOWDITCH. Feeding for butter, I would feed from half a bushel to a bushel of carrots a day, if I had them. That is the only root you can feed that quantity of without giving a bad taste to the butter. My feed now is about six quarts of mangolds, with ten or twelve quarts of carrots, besides four quarts of corn-meal, fed twice a day, in two rations, as the doctor suggests.

Dr. WAKEFIELD. That comes nearer your idea of grass than any thing else?

Mr. BOWDITCH. My cows make me better butter in winter on that feed than any other feed I have ever tried; and my butter, although perhaps not quite up to grass butter, has a very good flavor.

QUESTION. Have you ever tried parsnips?

Mr. BOWDITCH. Yes, sir.

QUESTION. Do they impart any peculiar flavor?

Mr. BOWDITCH. If fed in any large quantity, they do; but they do not help the color of butter at all. That is not, perhaps, of so much importance, now that we have as many good coloring-matters as formerly; but if you do not like to use any coloring-matter, if you have any pride about that, you want to feed your cows something that will give a good color to the butter without any extract.

Mr. SLADE. Do I understand you to say, that, when one cow in twenty ate shorts, the result was detected in the butter?

Mr. BOWDITCH. Yes, sir.

Mr. SLADE. Without the use of a microscope?

Mr. BOWDITCH. I don't know what he had, but he informed me of that. I like to feed certain cows in my herd oil-meal. I can feed oil-meal to one cow without his finding it out, but he will find it out if I feed it to two or three. I cheat him as far as I can in that way without cheating myself.

QUESTION. Does he find any difference between the new-process linseed-meal and the old oil-meal which we used to get? The consignee in Boston told me that the new-process meal was either soaked in benzine or naphtha for the purpose of getting the oil out of it; and it does get it out too. Is there any difference between that and the old oil-meal?

Mr. BOWDITCH. There is so much difference that I would not think of feeding the new-process meal.

QUESTION. Can you get the old?

Mr. BOWDITCH. Yes, sir.

Dr. WAKEFIELD. Do you, or do you not, find that there is a difference in the milk or cream or butter that you produce in the winter by this food? Does, or does not, a given quantity of milk give a greater quantity of butter than it does in the summer?

Mr. BOWDITCH. I think there is very little variation in that. One reason that would make you think so is, that in summer a majority of your cows might be new milch, and in the winter, perhaps not farther along from calving, they would not give as much milk, but it would be very much

richer. I think that would be the difference. I have tested the same cow, that was a large milker and a large butter-maker; and I found very little difference, whether she was new milch in July or new milch in January, either in the quantity of milk or in the quantity of butter.

QUESTION. Have you had any occasion to use cotton-seed meal? and what are its relative merits compared with corn-meal?

Mr. BOWDITCH. I cannot feed cotton-seed meal and make the best butter. I only tried it in a very small way, and I was stopped at once by the same butter-taster to whom I have referred. I have fed a small quantity of cotton-seed meal to some steers in winter. I was afraid to feed much of it: it was very highly concentrated. I believe a little of it can be fed very advantageously, but I have had no experience with it.

The CHAIRMAN. I would like to hear from Mr. Hadwen how he keeps up the winter flow of milk.

Mr. HADWEN. I make milk for market, and it is the most important product of my farm. I have had a long experience, not only with the grade and native stock, but also with thoroughbreds. The best thing to make milk of is grass, if it is good and enough of it. When you bring your cattle in from grass in the autumn, — the time between hay and grass, — the best thing that I have ever tried, in connection with a little Indian meal or ground oats, is cabbage. But some farmers say, "Why! you can't afford to feed cabbage." I want to say to farmers that they cannot raise an acre of any product on their farm which will give them as much milk between hay and grass as an acre of cabbage. I have tried it for years, and I have come to that conclusion. From the middle of November to the first of January a good amount of cabbage fed every day to a cow will not only keep up and increase the flow of milk, but will add weight to the animal to a very remarkable extent. It builds on to the animal. As the Irish term it, it is a strong food.

Mr. RUSSELL. Don't it make the milk strong?

Mr. HADWEN. It does make the milk strong, but not in flavor. But in feeding it to cattle you must use a great deal of care. Cabbage must not be fed at haphazard. The rotten leaves of cabbage must not be fed; but the clean

heads, such as you would eat yourselves, fed at the proper time, impart no flavor to the milk that any man or woman can detect. I am not going to say that cabbage may not, under some conditions, flavor butter; but I say that it will not flavor milk so that it can be detected.

The time to feed cabbage is immediately after milking; and every leaf that is not consumed at the time of feeding must be swept out of the way, and they must not be allowed a leaf between meals. People who feed it in this way will find no inconvenience whatever from the cabbage-flavor in the milk.

Now, in connection with cabbage and good hay, — good hay is the best food, — I feed meal made of ground oats. I do not want to feed any shorts whatever. Shorts will increase the quantity of milk; but I do not make milk for quantity, I make it for quality. Quality is what I have to come up to every time, and that is my process of feeding between hay and grass.

After my cabbages are gone, then I come on to my best hay: I feed also meal and carrots. There is no root that will make milk of such consistency, flavor, and color, as will the carrot. For one who is making butter, or one who is making milk for market, and must make the best quality, I regard the carrot as indispensable. It is the cheapest root you can grow for cattle. I formerly fed the mangolds; then I mixed mangolds and carrots together, and fed them; and now I feed carrots alone. You must be very careful that your stock of carrots lasts until your cows go to grass; for, just as sure as you cease feeding them before that time, your customers will ask you what is the matter with your milk.

These things have grown out of a long practical experience; and of course a milkman who has supplied the same customers for more than a quarter of a century finds out the little weak points that he has to contend with, and prepares himself accordingly.

Mr. A. W. CHEEVER (of Sheldonville). I would like to ask Dr. Bowen a question. Mr. Hadwen states that in feeding cabbage, the best green feed of any after grass, it must be fed after milking, and then every leaf swept away where the cows will not get at it again before another regular feed. We were told by the essayist, Dr. Bowen, that the food

which cows take remains in the first stomach at least twelve or fourteen hours. I wish to ask the doctor if he can explain the philosophy of that fact which Mr. Hadwen presented. Can cabbage remain in the stomach of a cow fourteen hours before digestion commences, without imparting a taste to the milk, provided it does impart a taste if eaten immediately before milking, or at any time except just after milking?

Dr. BOWEN. My idea is, that it would impart some flavor to the milk, fed at almost any time; but it may not be perceptible in all cases. There is a difference in cows in this respect. Some cows will not impart the flavor of turnips, even, to their milk. Those cows are very rare, I admit; but there are those that I think would impart but very little flavor. A feed of cabbage would go to the paunch, where all rough food goes. It would remain there twelve, thirteen, or fourteen hours. It is brought up by the peristaltic action of the coating of the stomach to the second, and brought to the mouth; and then it is carried back again to the third stomach, and the fourth. I do not think the time of feeding cabbage makes much difference, excepting in this way: if it is fed immediately after milking, it goes into the paunch; and when the cow commences to chew her cud, the previous feeding is brought up, not the last one; digestion commences immediately; and the milk is not secreted as abundantly directly after milking as it is a few hours afterwards.

Mr. CHEEVER. The paunch is to be filled with cabbage all the time?

Dr. BOWEN. Yes, sir; but the absorption does not come from the food while it is in the paunch: the absorption comes from the food when it has passed from the fourth stomach into the intestine.

Mr. CHEEVER. I can see an explanation there, if it is only fed once a day. I supposed it was fed twice a day.

Dr. BOWEN. I suppose it would make no difference whether it were fed once a day or twice a day. The idea is, that the absorption of the cabbage shall go on before the milk is secreted.

Mr. WHITAKER. Is not that which gives the peculiar cabbage-flavor a gas which is continually escaping from it?

Dr. BOWEN. Yes, sir.

Mr. WHITAKER. Does that gas stop before it has perme-

ated the whole tissue of the animal? I have tasted turnips very strong in beefsteak after the cow had been fed on turnips. I have also tasted linseed-meal. Why not taste cabbage in the same way, if the gas permeates every part of the animal?

Dr. BOWEN. I think you can. The gas will permeate all the muscular tissues. But there is a constant escape of the gas from the system, which is carried off in the breath.

Mr. WHITAKER. Did you ever get sweet milk from a cow whose breath was not sweet? that is, if you could discover any disagreeable smell about the cow's breath.

Dr. BOWEN. I think not. I think it will taint the milk. I think milk is the most susceptible of taint of any substance, whether it is in the cow or out of the cow.

Mr. SHAW. Would it make any difference whether the cow was fed on cabbage before milking, or not?

Dr. BOWEN. If fed immediately before, I do not believe it would.

Mr. SHAW. Say within an hour previous?

Dr. BOWEN. If she commenced to chew her cud, she might bring up a portion of the cabbage; but, as a general thing, it will not come up until it is softened.

Mr. WHITAKER. Dr. Wakefield asked a question about what food would make the most milk. I believe that was without reference to quality. I will tell him what I think would do it: a bushel of brewer's grain, all the salt hay the cow would eat, and all the water she would drink after it.

Mr. HADWEN. I do not raise cabbage to sell, as a rule. I sell a few, when prices are high; but I have no hesitation in advising every farmer who is making milk to raise what cabbage he may want to feed from the middle of November to the first of January.

In relation to feeding, it is safer to feed cabbage immediately after milking than to feed it before. Something may call you away from milking a cow; or, if you have a large number of cows, it takes a little longer to go through the process than you are aware of: and, as far as my own observation has gone, any thing that has flavor goes immediately into the circulation. My father tells of an incident which came under his own observation, where a steer that was being driven to the slaughter-house passed through an onion-bed,

and caught up an onion, and ate it. The animal was slaughtered within a short time; and the flavor of the onion went into the circulation, and flavored the beef so that it could not be used. Now, if that steer had remained alive a sufficient length of time for the gases to have had an opportunity to pass from the body, then that meat would have been good. I think it is just so with the feeding of cabbage. I think the system is at first impregnated with the gases, or the flavor of the cabbage, when the milk has been withdrawn from the animal; and I think that the gases have an opportunity to escape before the milk is secreted in large quantities, and consequently it is not flavored with the cabbage, as it would be if it had been fed between the milkings.

Mr. PETERSON (of Marshfield). I do not wish to prolong this discussion, as it is quite late; but my personal experience confirms Mr. Hadwen's. Once in my life I had two thousand heads of cabbage on hand that were worth only three dollars a hundred. I had a sale for all my milk; and the question arose, when I put them into my cellar, whether I could not feed my cabbage to my cows, and get my pay for them in milk. I did so, and there was no complaint made all through the winter; and I never had such cream, even in summer time, as I had when I fed those cabbages. The cows had all they wanted to eat; and for four weeks — I take care of my own cows: I don't allow anybody else, except when I go to a meeting of the State Board, to take care of them — for four weeks they did not drink a drop of water, and saved me all that trouble. They got all the water they wanted out of the cabbages. When my cabbages were gone, I had a quantity of turnips; and I undertook to get along a little while with them, but I had to stop it very soon. They imparted a disagreeable flavor to my milk, and my customers would not use it. Besides that, my cows lost as fast as they gained when I commenced on cabbages.

QUESTION. Did you feed both your cabbages and turnips just after milking?

Mr. PETERSON. I did, sir; and still the turnips tainted the milk.

Dr. BOWEN. I am very glad to hear that point of feeding cabbage treated by practical men. Theoretically, I think the remarks of Mr. Hadwen are correct; for it is a fact that

cabbage contains more nutrition than almost any other vegetable, and it must increase the milk produced by animals.

Dr. WAKEFIELD. It seems to me that Mr. Hadwen knows as much about this cabbage business as any of the doctors. He has stated what I believe to be the fact; and I believe it, in the first place, because he says so; and, in the second place, because I know it is so, having tried it. Those are two of the very best reasons I can give.

I have fed cabbage; I have fed turnips; I am feeding turnips now. I believe that he is correct in saying that the time to feed them is immediately after milking. I believe he is correct, also, in saying that you must take every scrap from the manger immediately, and not let them have it for luncheon even. If they get any of it, the taste will appear in the milk. Cabbage is not so bad as turnips, and it may not be more likely to impart a taste to milk than carrots or beets; but there are some people so nice in their taste that they can detect either or any of them. Mr. Bowditch has told us that the man who takes his butter can tell if he feeds a little of a different kind of meal from that he has been in the habit of feeding. My taste is not so delicate as that: but I have tasted considerable butter, and have tried to cultivate my taste, make it keen; and I have found out that if I feed my cows with turnips, or cabbage, or any of the roots, at any and all times, the flavor of the vegetable will be imparted to the milk. That I know to be a fact. I cannot explain it. I do not know why it should be so. The doctor says there is not so much milk secreted just after milking; but the milk is continually being secreted, and being held in the udder from the time it is drawn at one milking until it is drawn at the other. It is true there is not so much collected. We do not get twenty quarts from each one of our cows. I don't suppose Mr. Bowditch would get twenty quarts at noon; but, if he waits twelve hours, he will get eight or ten quarts. There is more likelihood, perhaps, of the flavor being communicated if there is a large quantity in the udder than if there is a small quantity: but the fact is, that, if you feed these things at the right time, you do not suffer; if you feed them at the wrong time, you do suffer.

Mr. PIERCE (of Lincoln). As far as my experience goes,

I cannot feed cabbages to my cows. I sell milk. I have fed cotton-seed meal very extensively, — probably as much or more than any man in the hall; I have fed three or four quarts a day for the last twenty years to my stock of cows, using fourteen to twenty-five tons a year, and I have never had any complaint about the milk. I believe that where the cream will average fifteen per cent on milk from cabbages it will average twenty or twenty-two per cent upon cotton-seed meal, either combined with sprouts or shorts.

Mr. Hartshorn (of Worcester). I think if cabbage-leaves or cauliflower-leaves lie in the heap long enough to heat in the slightest degree before feeding them, there will be no flavor in the milk. But I have fed, as Mr. Hadwen has, a herd of fifteen or eighteen cows for years upon cabbages, all through the latter part of fall and fore part of winter, without having the least trouble. I supply a class of customers who are very particular about the quality of their milk, and I never hear any complaint from them. Cabbage makes a very excellent quality of milk, and, with meal added, makes good cream.

In regard to onions tainting meat, I will state one little incident that happened to me. One fall I had two fat hogs; and after gathering my onion-crop, some of the waste tops and scullions were swept down into the pen where the fat hogs were. One of those hogs was killed in a few days; and the moment he was cut open, a very strong onion smell was perceived; and, when some of the meat was cooked, the house was filled with a second onion smell. Neither the hams nor any part of the meat could be eaten by me or any of my friends, and I gave it all away. The other fat hog, which was in the same pen, was kept for about three weeks; and, when he was killed, that meat was sweet.

Mr. Grinnell. This discussion hitherto has been confined entirely to feeding neat-stock. I want to ask one question on a subject which I think will interest the farmers present, and more especially those from the western part of the State. Dr. Bowen suggests to us in the feeding of hogs or pigs, whose stomachs are not so large as the stomachs of the ruminants, to feed three or four times a day. I think that that is not in accord with the practice of the farmers in the Connecticut Valley, where they have made, for years, the

best pork that is made in the State. Their practice is to feed their hogs twice a day. They have the impression that a hog will fill himself in the morning, and lie down the rest of the day, and digest his food. I beg to ask Dr. Bowen whether that impression is correct, or whether he maintains that his statement was correct, that we should feed three or four times a day in fattening hogs?

Dr. BOWEN. That is just as you look at the question, — whether you are trying to get the most nourishment out of the feed, or whether you are trying to make the most profit. You can feed a hog enough of nutritious material in food to set him digesting. If you give him a heavy feeding, a good deal of the food passes through him undigested. The peristaltic movement, the natural contraction of the stomach, and the internal action of the pig, are very good. If the stomach is distended with a heavy feeding, the greater part of that food passes out undigested. I think those farmers of the Connecticut Valley who divide the same amount of food that others give in two rations into four, will get a better result from it, — that they will get more pork from it. I think the digestion will be more complete.

Mr. SESSIONS. This idea of tainting milk and butter by feeding cabbage and turnips I have heard discussed a great deal in institutes and farmers' clubs in the Connecticut Valley, where I live; and a theory has come to be adopted there, in accordance with the fact stated here by Mr. Hadwen and others, that no taint is imparted to the milk when the material is fed immediately after milking. The theory is this (contrary to what the doctor has given us in this essay), — that this material goes to the first stomach, and is ruminated then for hours, and the change which it thus passes through liberates the gas, and it leaves the system before there is much milk secreted. The doctor says this material remains in the first stomach twelve, fourteen, or fifteen hours; and that contradicts this theory. Our theory is in accordance with the facts; the theory which Dr. Bowen gives us would seem to be counter to the facts which have been ascertained by experiment. One of our farmers in the Connecticut Valley, who makes milk for market, and soils his cows, has sometimes sown oats and turnips together. The turnip-tops grow up almost as high as the oats; and he cuts

them together, and feeds them to his cows in the summer. It is generally considered that turnip-tops are a great deal more likely to taint milk than turnips; but he feeds this green food to his cows, being careful to feed immediately after milking, and does not hear the slightest complaint.

Another of our townsmen, who has the confidence of the whole community, Mr. McIntire of Chicopee, has told me that a man could feed a cow all the round turnips she would eat, after milking, and he would guarantee there would be no taint in the milk. He sells milk, but has, when his milk has been very plenty, made butter; and I questioned him about that, because I make butter. He said he had never had the slightest complaint about his butter. I do not vouch for these facts: I only state them as I find them. The theory we adopted was, that the material was ruminated before a great secretion of the milk. The doctor's ideas were different.

Dr. Wakefield. It seems to me there is one thing to be noted about this turnip business. If you gather the turnip-tops from the ground before they have time to wilt, and feed them immediately, they will not affect the milk nearly so much as they will when wilted. When I was a boy, I used to go barefoot; and when I was pulling turnips in the field, we would cut the tops off, and leave them in piles; and, if I wanted to warm my feet, I would go and stand on one of those piles. I believe there is something in that. I know if you feed turnip-tops that have become heated you cannot get out of the barn before you will taste the odor in the milk, or smell it. In the case to which the last speaker referred, the turnip-tops were cut with the oats, and carried immediately into the barn, and consumed; whereas, if you gather your turnips, and cut off the tops, and let them lie in piles and heat, then you get the taste, and you get the smell. I believe there is something in that. I have not experimented in that direction, so that I know certain, as I do about some other things; but it looks reasonable to me that there should be a difference.

Recess until two o'clock.

Afternoon Session.

Mr. Lane in the chair.

On calling the meeting to order in the afternoon, the Chairman introduced his Excellency Gov. Long, president, *ex officio*, of the Board, who congratulated the Board and the people of Bridgewater on the success of the meeting.

The Chairman. It has been suggested to me that the Governor recommend the establishment of an experiment station at Amherst College.

Gov. Long. I cordially concur in that. I recommended something of the kind last year. I believe an experiment station would be very valuable in connection with agriculture, just exactly as the United States has, in connection with fish-culture, a valuable experimental station.

The Chairman then put the question to the meeting, whether they would request his Excellency to recommend, in his message to the Legislature, the establishment of an experiment station at Amherst College; and there was a unanimous vote in the affirmative.

The Chairman. The first lecture this afternoon will be upon "Fruit-Growing," by Mr. Avery P. Slade of Somerset.

FRUIT-GROWING.

BY MR. AVERY P. SLADE.

The subject of fruit-culture has been so often discussed by this Board, that its introduction at this time may be regarded by some inappropriate.

But to those who are engaged in the business (and I see many around me who are) it is always interesting. The limited time allotted for this discussion will not allow me to go into the minutiæ of growing fruit, even were I competent to do so. I therefore propose to speak of the strawberry and the apple briefly; confining my remarks principally to some of the obstacles which lie in the way of their successful cultivation, and to suggest such remedies as experience assures us are the most effectual.

Prior to 1863 the cultivation of the strawberry in Bristol County was confined chiefly to horticulturists, — was not regarded as a commercial fruit, but as a luxury too expensive for general use.

Boston received its supply mostly from its adjacent towns and those of Middlesex County.

Hovey's and Cutler's seedlings were the leading varieties cultivated in those early days, possessing all the good qualities supposed to be needed in a strawberry.

The business at that time was looked upon by the average farmer as one of the fine arts; and its successful cultivation was thought to depend upon some secret knowledge, of which a fortunate few possessed the sole monopoly.

In 1863 the people of Dighton and Somerset ventured into the business on a small scale, using the above-named varieties with the Brighton Pine and a variety called the "Old Virginia." Finding the soil well suited to their growth, and the business somewhat profitable, it was gradually extended to the year 1866, when, by the completion of the Dighton and Somerset Railroad, Boston market was thrown open to their products. A new impetus was given to the enterprise, and the acreage was rapidly extended; and at the present time it would not be easy to find a farm, however large or small, in the eastern part of Bristol County, that does not have its strawberry-patch, say, from a quarter-acre to four or five acres in size.

It was soon discovered that a firm, hard berry was required, — one that would not only stand transportation to Boston, but that would stand reshipment after its arrival.

To satisfy this demand, the Wilson strawberry was chosen; it being very firm, hardy, and exceedingly productive. Though abundantly acid, and somewhat deficient in flavor, for fifteen years it was the berry of the million. Attempts have been frequently made to displace it by new varieties claiming to be its superior in all desirable qualities, but which, on trial, have signally failed; and cultivators have clung to it with the tenacity they would to an old friend. Within the last two or three years its peculiar behavior has been such as to force the conviction upon its numerous friends that it must be abandoned; and they are compelled to make choice of another possessing all its essential good qualities, without any of its vices.

The necessity of this change has had a tendency to produce, in some measure, a stagnation in the strawberry-growing. Good judges estimated that only about two-thirds of the acreage of 1879 and 1880 will be in bearing in 1882.

Growers are experimenting cautiously with new varieties, to which their attention is constantly being called, and will continue to do so until something is found that will "fill the bill," when the business will be resumed, and perhaps exceed its former proportions.

The strawberry is an uncertain crop, and by no means an easy one to raise, the frequent assertion of writers on horticulture to the contrary notwithstanding. New impediments yearly present themselves; and every succeeding year demands greater effort to insure success than was required the year preceding. Though I think this may be truly said of almost any crop, yet I think it is peculiarly so of the strawberry-crop.

The ravages of the cutworm, or the disheartening appearance of the blight, are either often sufficient to discourage the most resolute cultivator. The former we have learned in a measure to out-general, but of the latter we know absolutely nothing except its results. A field may be perfect to-day, to all external appearances, and to-morrow unmistakable signs of waning vitality are stamped on every leaf. The foliage quickly and mysteriously disappears, leaving the half-grown, sickly-looking berry exposed to the rays of the scorching sun, emphatically saying to the husbandman, "Thus far, but no farther, shalt thou go." The cause of the blight is merely a matter of speculation. Although theories are not wanting to account for it, yet none have been advanced that appear to stand the test of experience. It has been attributed to various causes; such as, too much or too little plant-food in the soil, the broadcast application of too much fertilizer, or the working of a minute insect at the roots. Some look for the cause in climatic influences, while others think that they account for it by saying that the plant has played out.

This phenomenon, though not confined to any particular variety, has developed itself most frequently on the Wilson, and has been one of the chief causes which has brought that plant into disrepute.

Another formidable enemy in the field, and one which makes it unsafe to calculate the profits of next year's crop by the number of plants set this year, is the cutworm. I will not describe him. Let the fortunate few who have never been forced to make his acquaintance remain in blissful ignorance. He does his work thoroughly. Commencing operations about the 10th of July, he continues till prevented by frost. His mission appears to be to cut the plant about one inch below the surface, separating the root from the top. Having destroyed one plant, he works a subterranean passage to the next nearest, and then repeats the operation. Although there is a great deal of monotony in his life, he never seems to tire. He is, however, entitled to the credit of one virtue, — he never eats the new root of the tender runner so long as he can get the more substantial food of the main plant.

Cultivators have been assiduous in their endeavors to devise some means of preventing the ravages of this destructive insect. It was thought, that, by ploughing the ground late in the fall, and exposing him to severe frost, it would certainly insure his destruction. Others have coated their land with salt, and ploughed it in, thinking, perhaps, to so season his food, that he would die of starvation. These efforts have failed. The practice more generally pursued is to go over the field daily, and, where the wilted leaf indicates his presence, dig him out, and kill him.

This practice, though suggestive of locking the door after the horse is stolen, surely prevents further depredations. The theory that he travels from one plant to another by an underground passage is by no means universally admitted, and is often met by the question, How does he know which way to go? and might he not travel a week without finding a plant? I would here say that unerring instinct is the surest guide.

To test the truth of this theory, I took from the ground a grub that had just completed the destruction of a plant, and tied a piece of red thread around his body, and replaced him where he was found, and covered him with earth. In thirty-six hours after, the nearest neighboring plant, which stood sixteen inches distant, was struck with death; and on examination I found the same grub at work, exhibiting clearly the mark of his identity. In spite of all the untiring efforts

made for his destruction, hundreds of acres are annually destroyed by this destructive agent.

I have one or two suggestions to make which have a bearing on this very important subject, — First, never set strawberry-plants on land which has not been in cultivation at least two years from the sod; and the second is, So manage as to induce or force your plants to throw out runners liberally before the cutworm commences operations. To insure this important result, prepare your ground in the fall, manure liberally, set your plants early, and cultivate thoroughly. I mean by setting early, as soon as the frost is out of the ground in the spring; and you can run a cultivator over the ground, put in your plants, and, if you should have any doubt in relation to the final result, drop a teaspoonful of standard guano or some high-grade fertilizer within about two inches of the plant just before hoeing.

Small strawberry-plants are preferable to large ones. They will take hold sooner after setting. They will send out runners earlier, and more of them, than large plants. By thus taking advantage of the one virtue which we claim for the grub, it is possible to produce a fair amount of foliage, though many of the old plants be missing.

One of the most powerful agents operating to discourage the small-fruit grower in Massachusetts is the severe competition which he is compelled to meet in foreign fruit. Shipments from the South commence early in the spring, and advance North as the season advances, supplying our markets with such quantities, at low prices, that the consumer becomes indifferent, if not cloyed, by the time the native fruit is ripe.

Virginia, Maryland, New Jersey, and Long Island were once supposed to be separated from us by a respectable amount of intervening space; but rapid transit annihilates distance, and they now enter the market with us in the morning: in fact, better than that; for the berries of New Jersey and Long Island, picked in the afternoon, are sold the next morning in Boston market before the Dighton and Somerset berries arrive. If their shipments would cease when ours commence, it would, to some extent, mitigate the evil. Our berries, on entering the market, find it well supplied, and prices down to hard-pan, and, although labelled

"natives," fail to secure but a slight advance. I have sometimes thought, that, when we were enjoined to "resist not evil," this particular evil was not contemplated. How to successfully meet this competition has been the subject of much thought and serious consideration.

The only way which seems left for us to pursue, and which commends itself to the good judgment of practical men, is to grow a berry of superior excellence, both in quality and appearance, and present it to the consumer in a better condition, in clean inviting packages, using cheap new baskets, not returnable, and by a systematic effort elevate the standard, as well as raise the price, of native fruit, cause it to be sold on its merits, and establish a reputation.

Commission merchants have a way of selling strawberries that is somewhat discouraging to the grower, who is careful in sorting and packing, and who fills his baskets in such a way that they will be full when offered for sale. A teamster drives up to the curbstone with twenty-five or thirty crates on his wagon. A buyer mounts the wagon, and throws open a crate, which is taken as a sample for the whole; and from this sample, after making all due allowances for deaconing, the load is sold. It is fair to presume that in this load are a half-dozen different grades of berries from as many different shippers. The glaring injustice of this operation is too apparent to be overlooked.

The question is often asked, Would you advise going into the business? I answer, No: at least, not extensively. The strawberry is not only a perishable, but an exacting fruit. That which ripens to-day must be consumed to-morrow; and it will stand less neglect than most any other crop, while there are other crops, which, with less outlay and labor, are more easily grown, and at the present time quite as remunerative, as the strawberry-crop.

I regard the apple as the most important fruit grown in New England, and I think I may safely say that it is of more importance than all others. Whether it be viewed in the light of a wholesome food, or as a profitable market crop, its value is too often underrated.

The soil and climate of New England are better adapted to its production than they are for the peach, grape, or pear; and, with proper cultivation, there is no good reason why we

should not export millions of barrels annually, instead of a million and a quarter, as we did in 1880.

The objection to setting apple-trees which is often urged in this fast age — that "we must wait so long for the fruit" — is unworthy of the patient husbandman, and is really of not much account when compared with the salutary lesson of discipline which we are taught in learning to wait. Could we plant a tree to-day, and pluck the fruit to-morrow, this very important lesson in life would be lost. We must learn to wait.

By fruit-cultivation I wish to be understood as meaning all that is implied by the use of it taken in its best and broadest sense. I mean by it, intelligent, thorough culture. The idea of ploughing a piece of land, and sticking in some trees, and then putting up the bars and leaving the field with the expectation of ever getting any decent fruit, is simply preposterous. Some twenty years ago an elderly gentleman who lived in my neighborhood suddenly became convinced that he ought to do something for posterity, as he termed it; and, as he found an orchard on the farm when it came into his possession, it was no more than right that he should leave one when he gave it up. While he was still seized with this laudable determination, the tree-peddler (a personage whom we all delight to welcome) put in his appearance, and sold him trees for which he paid him twenty dollars. They were forthwith set out in a piece of sward-land; that is, a sod was removed with a shovel, and the roots were put in the hole, and the sod, I think, replaced in an inverted position. He boasted of having set an orchard, and undoubtedly felt that his duty to posterity had been discharged. These trees received no subsequent culture, and some of them showed signs of life ten years after setting; but the most of them had been honeycombed by the borer, and were broken off close to the ground before they had attained the age of seven years.

I am willing to admit that the average New-England orchard is not a thing of beauty, and does not improve the landscape: they are evidently left to take care of themselves. Once in two years they are allowed to produce enormous quantities of inferior apples, only a small portion of which are fit for use. They are forced on the market because they

will not keep; and, although sold for all they are worth, the prices received will scarcely pay for picking and marketing: hence the growing prejudice against growing apples. Were I a young man commencing a farmer's life, I would sooner embark my fortune in an apple-orchard than any other fruit we grow in Massachusetts. If we would succeed in any undertaking, we should first avail ourselves of all the knowledge appertaining thereto, and then make a faithful and careful application of the same to attain the desired end.

The production of nice fruit is an enterprise worthy of our best endeavors. A prominent agriculturist, in speaking upon this subject, says that the matter of fruit-growing is a matter of horticulture, which I understand to mean agriculture on a small scale. Now, what can be done on a small scale, can, with extended means, be done on a large scale.

Let it be distinctly understood that I advise no one to set an apple-orchard without a determination to do thoroughly all that is required for the protection of the fruit. Every thing is important, — the location, the preparation of the soil, the selection of varieties, the quality of the stock, the manner of setting, and subsequent cultivation.

The destruction of the borer, the caterpillar, cankerworm, and coreworm, must not be neglected. The pruning of the tree; the kind and quantity of manure to be used; the process of thinning the fruit, and of picking, handling, and storing; the construction of the fruit-cellar, and its management; and lastly the final preparation and packing of the fruit for market, — these are some of the cardinal points to be observed to insure success.

There are those who regard shelter of great importance in locating an orchard. I think, perhaps, it may be well to secure it, where it is convenient to do so; but a young tree planted in a bleak situation, and accustomed to a wholesale breeze, protects itself by extending its roots farther and deeper than it otherwise would, were it not racked by the wind. The Island of Rhode Island is completely exposed to the raking winds of the Atlantic, and of Mount Hope and Narragansett bays, and yet she can justly boast of some of the best orchards in New England.

SOIL.

In selecting the soil, choose a clayey loam; and, if water is inclined to stand on any part of the surface, it should be underdrained, but not otherwise. It should be rich in mineral manures, and it should never be allowed to become exhausted.

VARIETIES.

In making choice of varieties, one should be governed, to some extent, by the market he intends to supply; but in all cases it is safe to set liberally of the best winter-keeping apples. I am told that in foreign markets the color of an apple has much to do with selling it, and that prices rule in favor of bright red. Having decided on the varieties, go to a nursery, and select from the rows the very best specimens, even if you must pay for the privilege. We judge of quality by comparison; and, where objects stand side by side, we are enabled to choose the best without hesitation. Trees, like animals, are constitutionally strong or weak: if weak, a constant petting and nursing may prolong their existence, but will never atone for their inherent weakness.

Effectual methods of checkmating the cankerworm and borer are too familiar to need a repetition; but the coreworm, or coddling-moth, is not so easily controlled. I regard him as decidedly the most formidable enemy which the fruit-grower has to contend with. We are told that he is the lineal descendant of a miller, who about the last of June, and in the night-time, flies among the trees, and lays her eggs in the calyx of the apple. In a few days the eggs hatch, and the young worms burrow in the apple, eating their way to the core. In about twenty-five days they attain their full growth; and, having subsisted on the heart of the apple, it drops to the ground. They then leave the apple, and secrete themselves under the bark of the tree or elsewhere; and in due time another generation is sent out on its destructive mission.

Many remedies have been devised to destroy this pest. Stocking the orchards with fowls has in many instances been followed with complete success. Where this is not practicable, scrape the trunks of the trees the last of July,

and then wash with a solution of potash or whale-oil soap. Pick up and destroy all wormy apples, and you will find that you have done much to check their propagation. Allow me to quote from an eminent writer on this very point. He says, "Perhaps the best remedy for this and many other little pests is the scriptural one, 'Dig about the tree, and dung it.'" That is, give it greater vigor of growth; make it more productive, so that a portion of the fruit will come to maturity in spite of all insects. It is a well-known fact, that the most vigorous-growing, thrifty trees correspond with thrifty farmers, — the more they have, the more they gain. Insects mostly attack the most neglected trees.

As bearing upon this subject, I cannot refrain from expressing what has been the result of long years of close observation. When the ears of corn do not fill out, and the grape-seed does not catch, we attribute it to the dry weather. When the hay-crop is light, we say that the grass-roots were winter-killed. When the potatoes are small, we attribute it to having planted small ones; and sometimes strawberry-plants do not freely throw out runners, and we lay it to the peculiarity of the season. Now, in all these cases I have noticed that these results are most likely to occur where manure is used the most sparingly. There is nothing that will make the grass look so green to the farmer, or that will cause him to see so much blue sky every day in the year, as liberal manuring. In fact, manure is the grand panacea for a large majority of the ills which vegetable life is heir to. Manuring fruit-trees is absolutely essential to success; and yet how rarely do we hear the inquiry for the best manure for an orchard. The apple-tree is a gross feeder, and takes from the soil large quantities of manurial substances, which must surely be restored to keep the trees in profitable bearing. Nitrogenous manures should not be applied to trees bearing fruit, as they induce a vigorous growth of wood and but little fruit.

A popular objection to planting apple-trees is, that they never bear when apples are scarce, and bear abundantly when they are plenty. The tendency to bear enormous crops the even year, and omitting to bear the odd year, thus inaugurating alternately a feast and a famine, has ever been a perplexing and discouraging characteristic of the apple-

tree ever since William Blackstone planted his orchard on Boston Common.

The matter of changing the bearing year has been pretty thoroughly discussed from time to time, and still the problem remains unsolved.

While it has generally been regarded as "a consummation devoutly to be wished," but few, I apprehend, have sufficiently and carefully experimented, so as to determine whether the possibility of making the change lies within the bounds of human attainment.

Were it an easy matter to make the change, all would do it; and in a few years we should be no better off than at present: the odd years would be simply years of plenty, instead of the even years. Hence it is plain that it is not the *bearing* year that needs our attention so much as the *barren* year. In fact, the thing really desirable, and the one we should aim to accomplish, is a fair yield of choice fruit every year. I have strong reasons for believing that by proper and judicious management this end can be attained.

Nature is ever prodigal in the provision she makes for the preservation and perpetuation of species. Hence the tendency of most all fruit-trees is to set more fruit than they can perfect: especially is it so with the apple; and the barren year is undoubtedly the result of exhaustion. Now, if the tree can be relieved of its burden in a measure the bearing year, and stimulated to production the following year, is it not reasonable to suppose, that, by following up the treatment a few years, this most desirable result can be accomplished?

Orchards located near woodlands, or any place where partridges pass the winter, seldom fail to produce uniform crops of apples. When a deep snow cuts off their natural food, they resort to the apple-trees, and feed on the buds, thus contravening Nature in her prolific intentions.

A young man from Bristol County, who went to Pennsylvania some twenty years ago, wrote me in the spring of 1875, saying, "I took your advice, and set an orchard of two hundred trees. I wish you could see it. My neighbors regard it as a model of perfection. It has been in bearing five or six years; and, although it only bears the even years, it is the most profitable investment I have made since leaving the old

Bay State. Now, my object in writing, more particularly, is to learn if there is any way known among men by which it can be made to bear every year. I am willing to make the effort, if I knew what to do. Please advise me." This inquiry led me to think on the subject somewhat closely; and the advice I gave him is involved in the principle above stated. I told him to remove one-half or two-thirds of the fruit the bearing year by the time it had attained the size of walnuts, then early in the fall work in the manure or fertilizer, and in the spring following prune severely, if the trees will bear it. In a letter received from him, dated Nov. 6, 1881, he says, "I must tell you about my orchard. I have astonished the natives by raising a fair average crop of the handsomest apples you ever saw, and the odd year at that. I had but few in 1877, but quite a crop in 1879; but this year my crop is quite equal to last year. You can hardly imagine how much the thinning improves the apples in size. I do not allow them to bear one-half as much as formerly, and yet I realize much more for the crop. I feel confident that your theory is the right one, and I also feel sure of a crop of apples every year. An old Dutchman whose farm joins mine seems to be perfectly bewildered at my success. He says that he always *knowd* a Yankee man could do every thing, but didn't know he could do dat ting."

I do not claim, of course, that a single experiment establishes a theory; but that the remedy we are seeking lies in this direction, I have not a particle of doubt: and I firmly believe, if apple-raising could receive the careful and thoughtful attention which its importance demands, that no department of farm-husbandry would better reward the cultivator.

From what has been already said, the imperative necessity of thinning the fruit becomes apparent; and, where there is a determination to do it, the process is not so tedious as might at first be imagined. A light pole, the length depending on the size of the tree, with a wire spindle in the end, and a codfish hook, or something resembling it, fastened by the side of it, makes a very convenient implement for doing the work. A moderate amount of skill, combined with good judgment, is only required to complete the undertaking. In relation to picking the fruit when ripe, I have only to say, that that method is best, whatever it may be, which takes

the apples from the tree, and transfers them to the fruit-cellar, with the least possible chafing or bruising.

The tendency of the apple to decay during the moist warm weather which we sometimes have after harvest has been regarded as inevitable, and has had a discouraging effect on this branch of rural industry. Instances are not wanting, where, in sixty days after picking and barrelling, the shrinkage by rot has amounted to seventy per cent.

Scientific investigation has revealed to us the fact, and repeated experiments prove, that apples carefully grown, and subjected to certain conditions, can be kept in a good state of preservation for almost an indefinite period of time. This must be regarded as one of the very important contributions which science has made to agriculture.

Any apartment where the light, moisture, and temperature can be controlled at pleasure will afford the requisite conditions.

One of the least expensive, most efficient, and commodious fruit-cellars that I have ever examined comprised a portion of a barn-cellar.

The barn was forty by eighty feet, the length running east and west. About sixteen feet from the north wall another partition, averaging two feet in thickness, was built of stone laid in mortar; and the inside of all the walls and floor was made smooth by a thick coat of cement. The entrance was at the east end, by double doors, the inner one containing a sash. The windows on the north and west consisted of a single sash shielded by wooden shutters on the outside. On the south side of the apartment were two bins seven feet and a half wide and a foot and a half deep, one above the other. Where one has a commodious barn-cellar, and plenty of stone on the farm, I estimate that the cost need not exceed a hundred and fifty dollars.

I was in this cellar early in the spring, and found the temperature at thirty-eight degrees; while outside it was sixty-three degrees. The bins were filled with apples; and, although they exposed to view a hundred and twenty-five surface yards, I failed to find a single specimen showing any signs of decay.

But let it not be understood that the work of keeping fruit is completed. The building of a fine house is one thing,

but housekeeping has been found to be something entirely different. To manage a fruit-cellar successfully requires skill, judgment, and a constant supervision. The light should be admitted sparingly, the air kept pure, and the temperature low and uniform.

Apples for market should be carefully packed in barrels, and the head of the barrel so firmly pressed in, that under no circumstances should they be allowed to move in the barrel. The package in which any fruit is presented to the consumer has much to do with the price he is willing to pay for it; and he who uses old barrels instead of new, because he can save ten or fifteen cents apiece in the purchase, has yet a lesson to learn. Putting new wine into old bottles would indeed be wisdom, compared with the folly of putting choice apples into old, musty barrels.

Of course, none but first-class fruit should be shipped long distances, as the freight is regulated by quantity, and not by quality. In sorting and packing apples for shipment, whether they be intended for foreign or domestic market, great care should be taken to have them uniform in size and appearance. Supposing them all to be perfect, large and small should not be packed in the same barrel. Where Nos. 1 and 2 are found in the same barrel, the latter invariably fixes the price for the mixtures.

A friend who has spent three years travelling in England, and countries bordering on the North Sea, assures me that the market for American apples is absolutely unlimited; that the bulk of those grown there would not compare favorably with those which the Berkshire farmer grinds for cider. When a steamer arrives, one of the first things sought for on the invoice is American apples; and the supply has ever fallen short of the demand. Baldwins are now selling (Nov. 1, 1878) on the wharf, as they come from the steamer, for one pound per barrel. The most of the shipments are consumed in the seaports where they are landed, and you rarely find them in the interior.

The belt in which the apple grows to perfection lies comparatively within narrow limits, embracing scarcely ten degrees of latitude. The advantages it offers to the fruit-grower are evidently not fully appreciated.

Much of the fruit which was formerly shipped to New England now finds a market west of the Mississippi.

The business of canning and drying, though of recent origin, has assumed enormous proportions, and, while it causes a constant drain on the market, makes it possible to supply the remotest nations of the earth with the products of the American orchard.

The CHAIRMAN. We would like to hear how Mr. Brown of Lunenburg keeps his apples.

Mr. J. F. BROWN. I have, perhaps, paid as much attention to the keeping of apples as any farmer in the State. I have not been able, so far, to keep them the year round in large quantities. Something was said by the essayist about my cellar. It is on the north side of the barn, a hundred feet in length, covered by the hay-mow, with the walls as Mr. Slade described. I am able to keep it at a low temperature by double windows and doors. After admitting cold air in the fall and early winter, we close the windows and doors, and keep the cellar at as even a temperature as possible. The secret of keeping apples is to keep them at a moderately dry, even temperature, as near thirty-two degrees as possible. Apples will not injure at a temperature of twenty-six or twenty-eight degrees.

Mr. RUSSELL. How long do you keep them?

Mr. BROWN. I can keep them to June or July.

Mr. DAVIS (of Plymouth). Is not the cellar damp?

Mr. BROWN. It is underdrained to carry off the moisture, and the cemented floors keep it perfectly dry.

Mr. SLADE. How large an orchard have you?

Mr. BROWN. I should judge some twelve to fifteen acres.

Mr. SLADE. What proportion of the trees bear the odd year?

Mr. BROWN. We have more fruit the odd year than the even year.

Gov. LONG. How have you brought that about?

Mr. BROWN. By cultivation, I think.

Mr. SLADE. Have you trees bearing every year?

Mr. BROWN. Not largely. Perhaps they do to a certain extent; but it is not expected that trees can bear very heavily every year. My method of getting them into bearing the odd year was by cultivation, which I think had something to do with it.

Judge DAVIS. Do you let your apples stay out of doors before you take them into the cellar?

Mr. Brown. I take them immediately from the orchard into the cellar.

Question. What is your method of cultivation?

Mr. Brown. By ploughing, keeping the orchard up, and keeping it fertilized properly.

Gov. Long. Did that change it into the odd year?

Mr. Brown. I think it did. Trees, by the usual method of culture, cannot produce a large crop two years in succession; but, by giving the orchard extra care, we get a good crop the second year. That is, we may: I do not say that it is sure; but, by making it bear the second year, it becomes pretty well exhausted, and of course the trees then require rest, and, by going over the even year, they are ready again for the odd year. That is what I have arrived at, and I have had good success.

Question. What kind of fertilizer do you consider the best for an orchard?

Mr. Brown. I do not know any thing better than ashes or potash.

Question. What distance apart do you set your trees?

Mr. Brown. Thirty-three feet.

Mr. Pierce. Have you practised fertilizing with potash salts?

Mr. Brown. I have not practised it much, only with my peaches and grapes.

Question. Do you barrel your apples immediately after picking them?

Mr. Brown. It is my practice to take them from the trees, barrel them, and take them to the cellar on a spring wagon, and immediately deposit them in this cellar, in the barrels, unless I am short of barrels.

Question. You head them up at once?

Mr. Brown. Head them up at once.

Question. Do not apples keep better by being picked a little before they are fully ripe?

Mr. Brown. An apple in that condition would be likely to wilt too much. The time for picking apples is when they are thoroughly grown. I would have the fruit fully ripe before picking; that is, fully matured.

Question. Not mellow?

Mr. Brown. The apple then is beginning to decay.

At this point the Chairman introduced to the audience Hon. ARTEMAS HALE, a gentleman ninety-nine years old, and the oldest ex-member of Congress living. He was very cordially greeted, and said, "Gentlemen, I cannot make a speech. I am very happy to see you all. I have been very much interested in the cause in which you are engaged for many years, but my time has gone by for labor."

Dr. BOWEN. I would like to ask Professor Maynard as to the most recent scientific opinions in regard to keeping apples, — the degree of moisture that is essential. I am prompted to this by having eaten, last year, English Beauty and Russet apples that were two years old, that had been kept in a very moist cellar, — a cellar that contained water the greater part of the year, but which has the reputation of being the best keeping cellar in our town.

Professor MAYNARD. If the temperature is kept low, I do not see any reason why they should not keep in a moist cellar as well as in a dry one; and of course, if kept there, they would be less liable to decay.

The CHAIRMAN. If there is any gentleman here who can keep apples the year round, or has the knowledge that it is possible, we would like to hear from him how to do it. Is there any one here who will tell us the best way to raise peaches? I will call on Capt. Moore of Concord.

Capt. MOORE. I have been raising peaches for a few years; and of course I have experienced the same trouble that every peach-grower finds, and that is, a disease called "the yellows." I know that there are some horticulturists who say that there is no such disease; but certainly there is something that we call "the yellows," that kills the trees. So far, no one has cured that disease, that I have discovered. I known Dr. Goessmann has said that he could cure it, but I think he would hardly say that he had cured the disease until further trials. That is the only difficulty in raising peaches. I have succeeded in raising peaches, and had a fine crop this year on most of the trees. I had some few trees that had the yellows: those trees are now pulled up. I think that you can grow peaches a great deal better if you keep all animal manure away from them, if you will give them plenty of ground bone and plenty of potash salts, if you cannot get ashes. If I had plenty of wood-ashes, I

should not care any thing about potash salts, because I should not only get potash, but I should get some phosphate of lime, in the ashes. With that application, you will certainly get better peaches than you can with animal manure. The reason, I think, is that peach-trees, when they are young, ought not to be forced. The first two or three years they grow very fast. You want a fair growth, but not a growth the second year of six or eight feet on a limb (as they will grow if you give them much manure); because, if you grow them in that way, they are very liable to winter-kill. I want a peach-tree grown in a peculiar way. I have a piece of ground covered with peach-trees planted about five years ago. There are about seventy-five of them; and I think seventy-five handsomer peach-trees never stood in Massachusetts in one lot.

If you ask me how I would go to work to raise a peach-orchard, I say, I want to get one-year-old trees, and plant none older. I would like trees that have had a good growth, say five or six feet high. Then, before I planted them out, I would cut off all the broken roots, trimming them off nicely with a knife, and trim off every side-branch of the tree. I have then a straight stick. I would set them out in that way, and then cut them all off to a height of about four or five feet from the ground. I want them to branch out up there. That is contrary to the usual way of growing peach-trees. People say they want to have them branch out close down to the ground, because they will not split so badly, — they won't be up so high in the air. This is an error; for, if you allow them to branch low, the branches will run up at a pretty acute angle, and that angle will always split.

After treating the trees as I have suggested, after the first year's growth, at any time of the year you choose, shorten off those leading branches perhaps to a foot in length. When you shorten them, cut to an outside bud. The difference between cutting to an outside bud or an inside bud is, that the inside buds run up straight in the centre of the tree, and get up in the air, where you do not want them. Cut to a bud pointing outside, and that branch will take a curve, grow outward, and spread the tree. That is the first thing to do. Then you follow that up about three or four years. Let the small branches go, and cut the strong

branches, some of them as large as your finger, perhaps, because the tree will get to growing pretty strong; and the result is, that you have a tree with the branches growing almost at right angles. You can load that tree down to the ground, as Mr. Russell has seen on my place, without any prop, without breaking. It is very difficult to break a branch on a tree that comes out at right angles, or nearly at right angles. Then you have a tree that does not run up into the air: it is handy to pick from. The same thing would apply to apples, if you were going to thin apples, as Mr. Slade recommends. Trim the tree so as to keep it from growing too high: it can be done very easily, if you train it the first four or five years; if you let it go three or four years, it is pretty hard work to bring it down where you want it.

Peach-trees do not last so long as they used to, owing to this disease that I have spoken of. You want to cut these strong branches back every year; and, when they get out of your reach, take one of those little pruning-knives, and fit it on a pole like a rake-handle, and cut the strong branches, which do not bear fruit to any great extent, leaving the small branches to bear your fruit, and you will have on those trees all the peaches that the trees can stand under, as I did this year.

In order to show what I mean by thinning peaches, I will say that I told my man to thin the peaches; and, as he did not thin them half enough, I told him to thin them again; and then we had a storm that blew off a good many of them; and then they were thinned again, and that got them about right. If the buds are not winter-killed, there is no danger that a peach-tree will not set fruit enough. Now, whether the buds are winter-killed, or not, depends a great deal more upon whether the wood is ripe in the fall. If you have a very dry fall, the wood ripens, as it did last year; and, although the winter was one of the most severe we ever had, the peach-trees went through all right. Manuring with animal manure, and making a great growth on the tree, prevents the wood from maturing in the fall; whereas, if the tree makes a more moderate growth, and a growth that will bear the fruit better, with bone, or with ashes, or bone and potash, I think the wood ripens better. There is

another point. The chairman of the fruit committee of the Massachusetts Horticultural Society has told me, that, for the last three years, there have been no peaches in the horticultural rooms of so high flavor as those that came from my trees. The garden committee of that society, when they went up to my place, passed a very large peach-orchard in Concord, in which there were probably three thousand baskets of peaches picked this year, and they said that they did not find one really high-flavored peach in the orchard; but that on my place, which they visited on the same day, it was entirely different. Now, I cannot see any other reason for this, except the different method of manuring.

I will say in regard to my land, that, when Professor Stockbridge was there last September, he said that if I was in the western part of the State, they would shut me up in the insane-hospital for trying to grow grapes, peaches, or any thing of that kind, on such poor land. But the land is better than it looks.

Mr. Hadwen. Don't you think that thinning the fruit will have as good an influence as manure in flavoring it?

Mr. Moore. You can take off one-half the peaches on a peach-tree, if it sets ordinarily full, and you will have, perhaps, just as many bushels of peaches, and the peaches will be worth three times as much for being thinned; and of course, where they are allowed to perfect themselves, the quality is better.

Question. How about the borers?

Mr. Moore. They do not trouble me much now. I believe I have got ahead of them. You all know, that, if there are any peach-worms in a tree, you will find the gum around the butt, and immediately under the bark (they do not go into the tree much, as the apple-borer does) you will find the borers. They can be cut out very easily with a knife. I, perhaps, have five hundred peach-trees. I thought I would make up something that would suit the borers. I know oil-soap is good. I don't know whether the other ingredients I used amount to any thing, or not; but I know they make it thick. I put about twenty-five pounds of oil-soap into a tub, and dissolved it; then a bushel of cow-manure, fresh from the stable, was put in and stirred up; then a bushel of clay and five pounds of sulphur were

added. That makes a mixture that stays on the tree some time. I dug away around the butt of the tree, and put it on thick from the branches down. Where I have used that, I have not seen any more worms for a long time. At any rate, they do not trouble me much now.

QUESTION. Does not digging holes into the tree have a tendency to injure it?

Mr. MOORE. I do not think it injures the tree as much as the borers do. If I had only the borers to contend against, I would not borrow any trouble in regard to raising peaches.

The older people in this audience remember when every one could grow plums. They also remember that we had a black wart that destroyed the trees, and the curculio that destroyed the plums. It is a well-settled fact that the black wart is a fungus: there is no doubt about it; the worm theory is exploded. You may sometimes find the larvæ of the curculio in the soft bunch that comes out before the wart turns black, but it is not caused by the curculio. The difficulty seemed to be to get rid of that black wart. I think that is mastered with a little care. I planted thirty plum-trees about five years ago, and they have borne full the past two years. I wanted to beat the curculio, which is very plenty at my place, and I thought I could beat the black wart: so I planted those plum-trees in my hen-yard, shut the hens in, and they are bearing full crops every year. The first two years I had two black warts. One of them came out on the side of a large branch of the tree. I took my knife and cut it out clean down to the solid wood. If you had them on little branches, it would be better to cut the branches off. I did not want to cut off this branch. The custom has been this, in regard to the black wart. It has been treated as a fungus; and the limbs where the black wart showed itself have been cut off, and dropped on the ground; and it has been proved that that fungus will live right through the severest New-England winter on the ground, and be ready to propagate itself the next spring. There is only one way to get rid of it; and that is, when you cut off a black wart, drop it in the stove, and then be very careful of the ashes, and you are all right. I have thirty trees in one piece of ground, planted five or six years ago; and, for the last three years, I have had no black wart, although there is plenty of

black wart about my place on the wild-cherry trees, and plenty on some of my neighbors' trees. I think you can keep that off without any trouble.

Mr. BROWN. What time do you head in your peach-trees?

Mr. MOORE. Any time from now up to spring.

Mr. BROWN. Is it not better to do it earlier in the season, before the trees cease to grow?

Mr. MOORE. The result would be, that you would force the trees into growth, if you cut them back as I cut them. You would accomplish just what you desired to prevent, really.

Mr. BROWN. A peach-tree grows very late in the season.

Mr. MOORE. It is a better way to encourage early growth, and then refrain from giving them stimulating manures, which produce a large growth.

QUESTION. Did you ever use coal-ashes on peach-trees?

Mr. MOORE. Yes, sir.

QUESTION. Do you think they are worth any thing?

Mr. MOORE. Yes, sir. I think they are worth carting off anywhere, where you have got them around. I use all mine. We burn in the greenhouses, and in the house, perhaps forty or fifty tons a year. I do not throw any of those ashes away.

QUESTION. Where do you put them?

Mr. MOORE. I put them around my peach-trees, some of them.

Mr. PEIRCE. Do you think the disease called "the yellows" is conveyed from tree to tree by pruning?

Mr. MOORE. I know it is said so; but I have got so that I believe very little of what I hear, unless I have tested it. The older I grow, the less disposed I am to accept any thing that is brought forward, unless I have tested it. It is claimed that this disease spreads faster when the tree is in blossom than at any other time; that is, when you have a full bloom on the trees, there is more "yellows" developed than other years. The yellows develop on a peach-tree generally after a crop, and when you are getting the second crop, more than any other time.

Judge DAVIS. Have you seen any trouble this year in quinces?

Mr. MOORE. I have seen trouble; but I have had no ac-

quaintance of my own with it. I lost my quince-trees several years ago, and never replaced them. Mr. Slade, referring to the apple, spoke of changing the bearing year by picking off the apples. That, I should think, might have a tendency to do it by reducing the crop, because it is well known that the exhaustion of any tree or of any plant does not come ordinarily from growing a large amount of fruit, but from perfecting a large number of seeds: therefore, if you reduce your crop of apples, so that the tree does not mature quarter as many seeds, the tree will be in a better condition to bear a crop the next year.

The CHAIRMAN. The audience would be pleased to hear from Professor Goessmann as to his mode of curing the yellows on peach-trees.

Professor GOESSMANN. I do not assert that I have cured the disease myself, but I am engaged in the investigation of the cause of this disease. There are different opinions in regard to the cause. Some consider it a fungus-growth in consequence of the condition of the juice of the plant, which may be due directly to an abnormal condition of the soil, or might be traced to exhaustion of the soil, the fungus-growth being secondary. I have made experiments of this kind. I began by feeding the plants with a mixture of phosphate, magnesia compounds, and potash, taking care to have a large excess of potash. Then, turning my experiments in another field of vegetable physiology to account, I applied muriate of potash, — a potash compound which has shown peculiar efficacy in the development of a healthy leaf-growth. Now, the first sign of a healthy fruit-growth is a healthy leaf-growth: without a healthy leaf, no perfect fruit can be produced. It has been found, that, comparing the action of muriate of potash with that of sulphate of potash (two potash compounds), the muriate differs widely from the sulphate; that in some instances (for instance, in rye and buckwheat) the muriate produces an unusually luxuriant growth of leaf, and a large grain, while the sulphate of potash, being potash as much as the muriate, — the same percentage, — causes a peculiar diseased condition (a yellow appearance of the plant), and therefore interferes with the proper development of the seed. This very remedy I have applied to the peach-tree. I have a friend engaged in following up the investigation with

microscopical observations; and, if his first observation is correct, there is no fungoid growth in that case. The only fungi which have been found are simply external, and therefore may be simply accidental and secondary. But he found (which confirms me in my views) that the cellular mass was overcharged with starch, that the peculiar action of the cellular system in that case was abnormal: in other words, the osmotic action of the cellular mass was interfered with.

We have a few peach-trees upon the college-grounds, one of which the professor of agriculture says is suffering from the yellows. It began four or five years ago. We are applying these chemical compounds. We applied first our mineral fertilizer, and then applied a large amount of muriate of potash, at the same time cutting the tree back about two years' growth. This year that tree shows as healthy growth as any peach-tree on that ground.

These are the facts, as far as they are at the present time on record. I do not pretend to say that I have found the secret; but I am on the way to find it out, if possible.

NECESSITY OF A STANDARD AXLE FOR VEHICLES.

BY JUDGE CHARLES G. DAVIS.

It is worthy of remark, that in that portion of the Commonwealth in which, from the nature of the soil, we are most likely to find sandy roads with ruts, the length of the carriage-axle, and consequent distance of ruts from each other, are also greater than elsewhere. In a section of country in which the soil is more compact, and the roads hard and smooth, the use of a long axle by its inhabitants would be of comparatively little inconvenience to a stranger travelling with short axles. In the part of the State in which you are assembled, in Barnstable, Plymouth, and Bristol Counties, and in the eastern portion of Rhode Island, we find what is known by many carriage-builders as the "New-Bedford Axle," five feet four and a half to five feet five inches, "out to out," in length. These limits very nearly coincide with the original limits of the Old Colony of Plymouth; and this length of axle may well be termed the "Old Colony Axle." These axles furnish, so far as I can

learn, the widest constant, unvarying, single set of ruts in the world. I do not mean that carriages are not made as wide as this anywhere else; but that nowhere else are they used so uniformly and universally as to set the gauge for pleasure and travelling carriages, and to make a uniform and inevitable rut from which there is no escape.[1] It is the only track so wide as to control the travel and convenience of other vehicles. It has sometimes been asserted that the roads are improved, and an advantage may be gained by two or more widths of axles in the same section. This might possibly be the case in sections of the State in which roads are uniformly hard and smooth; but, in the regions of the wide axle to which we refer, a narrow axle, only nine or nine and a half inches shorter, cannot escape the rut on one side or the other, and the shoulder of the rut on another side. There is a horse-track in the sand, rendering it inconvenient for a horse not in the centre between the ruts; whilst the result is, that the carriage is continually obliged to cross the shoulder of the ruts, and change fron one rut to another.

As we go west in Massachusetts, the customary track narrows to four feet four inches in Springfield, and in Berkshire to four feet eight inches, out to out; with light carriages, as narrow as four feet two inches to four feet six inches. The standard track in Maine, New Hampshire, New York, Western Rhode Island, in the larger part of Connecticut, and in almost all the Western, Middle, and Southern States, is four feet eight inches; whilst everywhere, except in the south-eastern section of Massachusetts, and its neigborhood

[1] On the contrary, omnibuses in New-York City, in which there are, of course, no ruts, generally track six feet six inches, but lighter ones, six feet two inches. In the Middle States (excepting New Jersey) the wide track, five feet two inches and a half, is used for city railways, without exceptions, to accommodate their old mail-coach track, which was five feet, centre to centre, or five feet two inches, out to out. In Australia the principal carrying-vehicle in use is built very strong, its carrying power ranging from four to six tons, and its standard track is five feet nine inches, inside to inside. But the carriage track varies; the manufacturers have no standard to guide them, and, as the necessity for such has not arisen, they are guided by individual choice, merely keeping in view the necessity of giving sufficient width of track to prevent their vehicles from toppling over too easily. In France the law prescribes the track of omnibuses to be 1.65 metres, or five feet five inches, for hind-wheels, and 1.55 metres, or about five feet one inch, for front-wheels. In practice this is reduced to 1.55 and 1.35; but the roads are excellent, and the carriages made for all tracks.

in Rhode Island, what is known as the wide track does not exceed five feet two inches.[1]

I have given in a note the dry statistics, as far as I have been able to ascertain them, of the width of carriage-tracks among the civilized nations of the earth. And now, what lesson can we learn from them? Is there any reason why there should not be a standard length, at least in New England, and even throughout the world? Is it desirable? If so, what should be the standard? and how can such standard be obtained?

The only advantage which I have heard suggested for the

[1] Throughout Central New York the wagon-track is four feet ten inches, out to out; in New Jersey, the State track, five feet, centre to centre, or five feet two inches, out to out; and in Hackensack and vicinity, four feet one inch. In the southern part of Pennsylvania, in Delaware and Maryland, including Philadelphia and Pittsburg, the wide track is five feet, centre to centre; but in the central counties of Pennsylvania the carriage-track varies from four feet six inches to four feet ten inches. In Ohio the State wagon-track is four feet ten inches. In Northern Ohio the narrow track, four feet eight inches, is most in use; but in the southern counties a wide track of five feet, centres, is used. In Indiana and Illinois the wide track is five feet, centre to centre; whilst in their northern and western counties the track is four feet eight inches, out to out. In the north-western States, Iowa, Michigan, Minnesota, Wisconsin, and nearly all Kansas and Colorado, the narrow track, four feet eight inches, out to out, is used; but in West Colorado, and until you reach California, the wide track of five feet is used. In Oregon, east of the mountains, is the wide track of five feet, centre to centre; whilst west of the mountains the narrow track of four feet eight inches, out to out, prevails. In California the stage-track is five feet two inches, centres, or five feet four inches, out to out; medium carriage-track, four feet eleven inches out; light-buggy track, four feet eight inches out. In the Southern States the widest track is five feet, centre to centre.

FOREIGN CARRIAGE-TRACK.

Mexico and Central America. — In Mexico the mail-coach track measures five feet to five feet six inches, according to route, but carriages sent there from New York generally have a five-foot track; and the Central American States average about the same as Mexico.

South America. — In Peru and Chili the track is four feet six and a half to four feet eight and a half inches; and in Brazil, of the same width as in England and France. *In England*, with good roads, the track varies from three feet eight inches to five feet.

In Continental Europe the roads are generally good, and the importance of uniformity is not pressing; but none of the tracks exceed five feet. Prussia, four feet four inches, centre to centre; Bavaria, three feet seven inches, centre to centre; Rhenish Bavaria, three feet eleven inches, out to out; Saxony, three feet seven inches and a half, inside to inside; Wurtemberg, three feet eight inches, inside to inside; Hesse, four feet one inch, inside to inside; Baden, three feet eight inches, inside to inside; Holstein-Lauenburg, four feet four inches, out to out; Hamburg, four feet six inches, out to out; Austria, four feet four inches, centre to centre. These measurements are in their foreign measures. For Austria add one-thirtieth of a foot to each foot named, and for all the other Prussian measurements add one-twentieth to each foot named.

long axle is, that it furnishes better facilities for turning. This is true, if the additional width is used in space between the body and the wheel; but, where the spaces are equal in two vehicles of different length of axles, the gain in turning is in favor of the shorter axle. The carriage-builders inform me that they experience no difficulty whatever in making or using wagon-bodies forty inches wide in the clear. This is wide enough for two provision-boxes which are nineteen inches each. But there are other considerations. As our roads improve, and are widened, there is not the same necessity for turning short that there once was. A man can drive his market-wagon or loaded team throughout Massachusetts, to market and back, with the necessity of no sharp turns. In the next place, many wagons are now made with the forward wheels turning under, and some with forward axle much narrower than the rear axle; and many others may be found, by a glance any day at Quincy Market, in which the body is built out over the wheels. Any objection to a narrower axle in Massachusetts than such as now obtains in the sections we have named, is founded rather on custom or prejudice than on experience or reason. What is perfectly satisfactory to the farmers of Maine, New Hampshire, Vermont, New York, and a portion of Massachusetts, cannot be seriously inconvenient.

What are the advantages of the narrow track? I will give them, not alone as my own opinions, but as those of practical carriage-builders and dealers throughout the land.

First, and perhaps of least importance, country roads through woods, and on by-ways in which there is little travel, may practically be worked a foot and a half to two feet narrower with an axle of four feet eight inches than with one of five feet five inches or five feet six inches; and thus results a saving in cost in the making and repair of such roads and lanes.

Second, the narrow axle finds its way easiest through woods, stumps, and all narrow and obstructed passages.

Third, a long axle requires not only the additional length, and weight resulting from its additional length, but the whole axle must be larger and stronger, and therefore heavier. There is, therefore, a saving in cost and in weight, and consequently in draught; whilst the additional length of body, if

any, in heavy wagons with less width, makes the same area, adding little, if any, to the weight of the body. There are few carriages made for narrow tracks which do not spring by the widening; and it is a matter of common experience, that carriages purchased in the city, and widened for our country roads, are sprung in the axle in a short time. Consider the difference in strength required in lengthening a bar of iron strong enough for its ordinary, reasonable maximum capacity, from four feet eight inches to five feet five inches. Carriage-building has become a science, as well as a trade, and no waste of iron or material is allowed; so that what would be safe and proper in an axle of one width would be unfit for one nine inches longer. Whether the difference in strength is more than the proportional addition in length is a mechanical question into which I will not enter. Although a leverage of two feet may not give more than double the power of a leverage of one foot, the additional power on a sudden shock, strain, or blow, such as mounting a frozen rut, is vastly increased; and this consideration is enough for our present purpose.

Fourth, there is another advantage in a narrow axle, growing out of the laws of physical forces. A narrow-tracked vehicle runs much lighter to the animal than a wide one, because the leverage is not so far from the centre line of draught. The jerking motion caused by the wheels of vehicles meeting obstructions first on one side, then immediately on the other, when passing over uneven surfaces, worries horses more, with an ordinary weight, than to pull a heavy load when the draught is equal on each side. It follows that the wider the wheels are apart, the greater the leverage, and consequently the harder the jerks and jams which horses have to bear and overcome: in other words, the power should be supplied "in the line of the best support," as a recent writer has expressed it. The nearer the power is applied in a line with the wheels, instead of a line between the wheels, the easier the traction. Accordingly, our horse-railway companies have found that their extra horse hitched in a line of one of the wheels does more effectual work. Under the same laws of traction, persons who have been in the habit of driving narrow vehicles find that in sudden attempts to turn out of a rut, or avoid an object, the car-

riage does not "mind her rudder" so quick on the wider axle; but the horse turns first, whilst the carriage lags. The shock to the axle and wheel is greater, and driving not so sure and safe.

Fifth, with two widths of track in use, these shocks we have just spoken of are vastly increased in numbers, even to the narrow axle. Light carriages suffer a greater strain while being forced from one rut to another, and by "cramping" and being crowded against the deeply-rutted ground, especially in winter.

Sixth, next let me call your attention to the advantage arising from uniformity. The narrow track, four feet eight inches, is the track we must practically conform to, as it is nearer the universal, uniform, and standard track than any other. I mean, that for the sake of uniformity alone, even if we may have our individual preferences for a wider track, the balance of advantage is in favor of conformity. To carriage-builders the advantage is, that they could build and sell for any section of the country. One carriage-maker writes me that the wholesale trade in carriages is increasing so rapidly, that they are shipped to all sections, and a standard track has become almost a necessity. Consider how large this interest has become. By our State census of 1875, the number of wagon and carriage manufacturers, not including wheelwrights, was 356 in Massachusetts, with an investment of $2,412,705 and a product of $4,343,458. They used a steam-power exceeding 1,000 horse-power, 3,072 hands, and paid out about $3,333,333⅓ for wages. By the United-States census of 1870, the number of carriage-establishments in the Union was 11,849, with a capital employed of $36,563,095, paying out over $21,000,000 in wages, using $25,000,000 of material, and producing $65,362,837 of products. This census included wheelwrights. The census of 1880 gives 3,052 carriage-builders proper, employing a capital of $32,683,123, worked by 47,000 hands, paid nearly $7,000,000 in wages, using nearly $29,000,000 of materials, and turning out over $56,000,000 of products, whilst the additional product of manufacturers of carriage and wagon materials was over $8,403,441. Massachusetts alone, in 1880, manufactured carriages of the value of $4,302,321. The figures represent an increased product in quantity, but a fall in wages

and materials from the figures of 1870. The carriage-builders of all sections desire uniformity; but it is not for their interest alone, but for the interest of the whole country, and the personal convenience of every man in New England, that this uniformity should be brought about. We in South-eastern Massachusetts cannot buy a carriage, and have the pick of the market: we have barred ourselves. We cannot invite entire strangers or friends to spend their summers with us: we bar them by a provincial and an inhospitable custom.

What should be the standard width? I have corresponded with various carriage builders and traders in this and other States, and find no disagreement upon this point. Generally throughout the Northern States the standard gauge of the street-railways is four feet eight inches and a half. In New-York State and City, and in New England, there are no exceptions to this rule of four feet eight inches and a half between the inside upper angles of the track. The tracks of city railways in the West are mostly standard gauge, the same width. In Canada, Mexico, and South America, the standard track (four feet eight inches and a half) is generally in use; and, as the carriage-track of Maine, New Hampshire, Vermont, and New York is four feet eight inches, that width is universally recommended by those who have dealings in carriages. One gentleman writes me that there is hardly a law which the Legislature could enact which would do more practical good than one which would enforce uniformity in this respect. All agree that it would be cheaper to widen than to lengthen an axle, and that by a standard track of four feet eight inches is meant a track four feet six inches from centres; four feet eight inches being from outside to outside. The editor of the "Hub," the organ of the "Carriage-Builders' National Association," to whom I am indebted for much information, has declared, that, "unless distinctly stated to the contrary, the track of a carriage is now always measured 'out to out,' the same as street-railways, by which the carriage-track of cities is largely influenced and practically governed."

How shall this desirable assumption be brought about? Mr. B. C. Shaw of Indianapolis, Ind. (whose firm are making a circle-track carriage, with spring gearings, by which, when the carriage turns, there is a spring joint in the perch, by

which the rear wheels turn in as much as the forward wheels turn out, and which avoids any trouble in turning), suggests that Congress pass a law making a uniform track for all government wagons, ambulances, gun-carriages, mail-wagons, etc., and thinks, that, if a government standard were established, State enactments might be made in conformity therewith. But we shall have to wait long for Congress to do any thing in practical matters. Let the Legislature of Massachusetts simply require, that, at the expiration of a certain number of years, all "teams" used for ordinary carriage of produce and merchandise, or passengers, excepting such as are *required* for extraordinary carriage (such as moving houses, etc.), shall have axles not exceeding eight feet and four inches, out to out, under a penalty; and let it be required that all exceptional vehicles shall be licensed by the municipal authority; and the work is done. The Legislature must emancipate those who cannot by any uniformity of action, in any other way, emancipate themselves. Let it remove from the Old Colony this narrow, provincial, inhospitable stigma; and whilst other means of communication between men and nations are hastened from day to day, let it not be said, that, in our little State, its inhabitants cannot drive from one end to the other without finding a change of carriage as common as a change of language in the counties of England or the provinces of Europe.

Mr. Brown. This is a subject I am glad to have brought up, as I have had it in my mind for at least thirty years, having once lived in a section where they ran carriages of one track, and removing to a portion of the State where they varied very much, all heavy carriages running in one track, and lighter ones, in proportion to their weight, varying considerably. You will readily see, all of you, I think, the advantage of having these varied tracks. I had occasion to visit this portion of the State early in the spring one year, after some thaws; and your heavy wagons being all of one track here, or most of them, I found a row of deep ruts in the road. To avoid one row of ruts, the next wagon that comes along passes over them, and cuts other ruts, and so on, until the road is all cut up. Now you will readily see the advantage of having the different tracks. In Worcester

County we run a variety of tracks, and you will readily see the difference in our roads. Where we run one heavy team, which will cut a wide track, perhaps there will be half a dozen lighter ones coming, which will vary in track; and the result is, we have a smooth road all the time. We have no ruts, except in portions where heavy teams are running all the time. It is almost impossible for us to visit this section of country with our light vehicles, because they run narrower, and go bobbing from one track to the other, and it is very unpleasant. For thirty years I have taken notice of that one thing. In the early days of the western country, the farmers used particularly heavy wagons, and there was the same difficulty attending deep ruts. You will find it remedied nowadays very materially.

The CHAIRMAN. No wagon can come into Plymouth County without a wide track.

Mr. MOORE. I want to say a few words as a farmer, to the farmers here, in regard to this question of the length of axles. In the vicinity of Boston, and all the cities in the eastern portion of the State (I cannot say about the western part), it has become the custom for farmers to sell their produce in bushel-boxes and in barrels; and they have their wagons built to hold two barrels and baskets abreast. Now, suppose you take these narrow tracks: you are going to narrow up the bodies, so that the wheels will be right up to the side of the bodies. Why should we do that? Why should we adopt the track which is adopted by the horse-railroads? That is no good reason. It is understood perfectly that they run the city of Boston; but we, as farmers, do not mean that they shall run the country at present, to say the least. I think that is a serious objection. There is another objection. You make a narrow track, and put a large load of hay on, as I have to, to go to Boston: you will have to haul out on the side of the road, and, if your wheels get into a rut, it will be a very easy matter to unload your hay before you are ready.

I think, with all these objections, although we might talk here all day about the length of axles, we cannot do any thing about it, and the Legislature will not do any thing about it. I am not certain but what the different tracks keep a better road throughout the summer than we should have if the wagons and carriages were all of one track, because they are not all run in one place, digging it out all the time.

Judge DAVIS. With regard to the suggestions which have been made, I will say that there is no doubt, that, if you had a uniformly narrow track, the carriages could, in the long run, be made longer, and you would not have to load so high. We say, "Shall not the Judge of all the earth do right?" I think we might with equal reason ask, "Is not the judgment of all the world always right?" Now, the judgment of all the world is, that a narrow carriage is not more liable to tip over, if the other conditions are changed, than a wider one. If you have your wheels of a gauge-wire narrower than the present one, have your wagon made a little longer, or, if you choose, three or four feet longer. The wheels need not be so high, in the first place, and the load will be more equally distributed. We carry a load of wood in a common horse-wagon, we call it; we carry a cord, if we can, with two horses; we put it in two piles of a certain height. If we wanted to carry a load of wood on a wagon with narrower axles, I think that, practically, all the difference would be, that we should carry our wood in three piles, instead of two; but the three piles would not be nearly as high as they are now. The difference in width would not be great enough to make a third pile of the same height as the two are now, and the result would be that the whole load would be lower than it is with the wagons in use at the present time.

Mr. BROWN. Don't you think it would help the roads very much if you had carriages of different widths?

Judge DAVIS. Certainly, if it is practicable; but it is not practicable where there are sandy roads, where there is but one track. If the law that was proposed last winter providing for wide tires were passed, that might make a difference. If you go up over the hill to East Bridgewater, you will find every team has a wide tire, and it can go anywhere. But practically, in this section of the State, the wide track controls entirely; and, if we have two tracks, they are both wide; and everybody who has a narrow axle hops along, wrenches his carriage, and gets along the best way he can. I do not think that, practically, the market-men would have any difficulty in getting along; for the market-men of almost all the world do get along, even with narrower axles than four feet and eight inches. I suggested that there were prejudices and difficulties to be encountered; for there is no old custom.

whether right or wrong, that somebody cannot be found to uphold: but I think the balance of convenience for the whole State would greatly outweigh the inconvenience, if we had a uniform axle.

Mr. Brown. If you would pass a law that all heavy wagons should be of a certain width, all market-wagons of a certain width, and all light carriages should be narrower, you would have level roads, and the ruts which we now find in some portions of the State would be avoided. I certainly think it would be a very great advantage to have no ruts.

The Chairman. In the absence of Professor Stockbridge, the paper prepared by him will now be read by Secretary Russell.

HARVESTING CORN.

BY PROFESSOR STOCKBRIDGE.

"Corn is king." So the trumpeter of his Majesty has proclaimed in no uncertain sounds. Yet the farmers of Massachusetts have been slow to acknowledge fealty, or pay tribute. They have thought the Bay State was outside the confines of his territory, and that his real realm was in the great valley of the West. But corn is king, nevertheless, "from the mountains to the sea;" and the sooner we arrange ourselves under his banner, acknowledge his supremacy, and obey his dictates, the better it will be for us. He holds sway, not alone by virtue of the absolute wealth he is able to bestow, but because of his ever present help in supplying the numberless wants of the farm, the family, and the home, and his contributions to the comfort and sustenance of his subjects. Dropping this personification here, we observe that the drift of agricultural opinion in Massachusetts from about 1865 to 1875 was, that we could not grow this crop with profit, either because of the cheaply produced and transported western product, or because of the demand of our markets for supplies, in producing which the West could not compete; and therefore it was a stroke of good policy to produce for this market demand, and purchase the corn needed for home consumption. Between 1875 and the present time, this opinion has been materially modified; and corn production has undoubtedly increased, though we have as yet

no reliable statistics showing to what extent. There may be favored localities where farmers, with high cultivation on small areas, can make a greater profit by producing perishable crops for a home market, and buying the grain they need; but it is not so with the average farmer of the State. Dense as our population is, we yet have a surplus of land — land on which taxes have to be paid — which now yields little or no income, and which, with proper treatment, is capable of producing remunerative crops of corn; which will have a tendency, not to diminish, but to increase, the value of other crops and of the farm itself. Statistics treat of this only as a grain-crop. So far as I know, the aggregate in tons or in value of the fodder is overlooked in gathering material for the compilation of census-tables; and the absolute value of the crop to the State or nation is based on grain alone. The "fodder-corn" produced in the State in 1875 is given as 15,863 tons, of a value of $164,458. This is but a tithe of the fodder of the cornfields. Judged by the acreage and yields of grain that year, the fodder could not have been less than 70,000 tons, with a value of more than $500,000. This item is one of too great importance to be forgotten in estimating crop values, in the economy of the feeding-stuffs of the farm, or the general utilizing and management of the crop. The Massachusetts farmer must grow it for the grain *and for the fodder;* and all the details of its care should be with both these objects in view. The soil, manures, seed, and tillage best adapted to the growth of Indian corn are all interesting subjects of discussion; but by assignment we are to consider only the best mode of harvesting it. This is done by three methods, each of which has its advocates, and, perhaps in varying circumstances, its advantages and disadvantages. The best method for one locality may not be so for another. At the West, where fodder of all the coarser kinds, and even good hay, are so plenty and cheap that they will bear transportation but a limited distance (and the crop is produced for the grain alone), the best method is one which will secure this in its highest perfection, even if the fodder is injured, or totally ruined thereby, for feeding-purposes. There the entire crop is allowed to stand in the field untouched, until the grain has drawn all the nutriment possible from the stalk, and is perfectly hard, when the ear is husked or picked,

and the stalk allowed to remain for roaming cattle, or to be ploughed under as food for a succeeding crop. This method is too wasteful for us; and, to secure its entire value, we harvest by cutting the fodder with the ears upon it, and secure the whole from injury by placing it in compact stooks. But just here is a vital question to be answered; viz., At what stage of its growth is it the best time to harvest it, regard being had to the best condition of the grain compatible with the best condition of the fodder? Of course, the riper the grain, the better its quality; but it will cure sound and hard in average seasons if it is harvested with the stalk, when it is getting out of the milk, and the outer end of the kernel is beginning to glaze. As all the ears of a field will not be in the same condition at any given time, harvest when an average shows a surface too hard to be easily indented with the thumb-nail; but at the same time regard must be had to the condition of the stalk and leaf, and the season. Whether ripe or green, it should be secured in the stook before frost. The grain will not perfect itself after the leaves and stalks have been frozen; and the fodder is nearly worthless. It may be said with truth, perhaps, that the leaves and stalks are in their most valuable condition for harvest while they contain all their albuminoids and phosphates, and before these materials are transferred to the grain; but they are still quite rich in nutritive elements when the grain is in the condition just described. They will then have changed their dark green to a shade of straw-color, the lower leaves and the tips of some of the upper ones will have begun to shrivel, and the whole crop is in condition to harvest with the greatest profit. Harvesting our larger varieties of corn, that will yield from seventy-five to eighty bushels to the acre by cutting it at the roots, is not child's play, but hard, laborious work; and sundry expedients may be resorted to, to lighten and hasten the process. The precise method pursued will be determined somewhat by the after-use which is to be made of the land, and the character of the help employed. If the field is to be sown to winter grain, and before the husking of the corn and the removal of the stooks, the following method will be the easiest and the quickest: Determine by the rows of corn the line on which the first row of stooks shall be placed, and there cut four rows of corn, and lay them in one row of bun-

dles of a size which a man can handle without extreme effort; then on either side of this row of bundles cut four more rows of corn in the same manner, but lay them on the ground with the butts of the stalks towards the row first laid down.

Rye-straw is the best material for binding these bundles, which should be done just as near the ears as possible; and, while the workman has the bundle in his hand, he should turn it over endwise, without lifting it, so that its tip lies where he can reach and set it into the stook without any carrying. Proceed in this manner, putting twelve rows of corn and three rows of bundles into one row of stooks, until the field is finished. This method will leave wide spaces between the stooks for ploughing and sowing; and the strip on which the corn stands can be ploughed and sowed before it is set up, or it can be done afterwards, which is preferable, if the crop is early. In cases where the cornland is not wanted for sowing, and the workmen are not strong and sturdy (which is the case with the speaker), another method may be adopted, which avoids much hard labor, and secures the crop with greater despatch, as follows: Select the corn-row on which the first row of stooks is to be placed, and bend over two hills of corn at the ears, and tie the tops together by turning them over each other in a half-knot; then cut two or four rows on each side of this, and, without laying them on the ground, stand them, handful by handful, in a bracing position, evenly about the two hills which have been tied together. Proceed in this manner until the whole field is completed. In heavy corn it is sufficient to put five rows into one row of stooks. A two-legged "wooden horse" is sometimes used to support the corn as it is cut; but in some respects it is not so good as the tied corn-hills. In both of these methods of harvesting, the stooks should be no larger than is necessary to enable them to stand firmly; should be so arranged as to permit a free passage of wind through them from the ears to the ground; and should have their tops turned over, and be securely bound so low as to strengthen and support them. Corn thus secured should not be considered as safe against all contingencies, or be left in the field until it suits the *convenience* of the farmer to put it under cover; for fall

rains, with high winds, may materially damage the stover, if not the grain. It should therefore be examined occasionally, and, as soon as cured, taken to the barn. The grain will usually be ready for the bin when the leaves are dry, and the stalks dry for half the distance between the ears and the ground. If the "stub" stalks are quite green, or contain visible juice, they will do no harm in the stack or mow, if the upper stalks and leaves are well dried. The method of husking must be governed somewhat by the weather, the floor-room in the barn for doing the work, and whether it is desired to save the husks separate from the rest of the fodder. One main thing in the process is to utilize time, and save expense, by handling the stalks as little as possible. This will be accomplished by picking the ears from the stalks in the field, to be husked afterwards, and then to cart the stalks directly to the storage-room. Husking in the field, with average hands, is objectionable, as more or less of the fodder will be wasted. The other method of harvesting to be noticed, and which is practised to a considerable extent, is called "top-stalking." It was the way of our fathers, and, for aught that I know, of the Indians before them. Theoretically it consists in cutting off the sterile stalks at the ground, and the fertile ones, smoothly, at the junction of the ear, when the stalks and leaves are quite green, and the grain just commencing to harden; but practically it is the cutting-off the top-stalks, with one clean sweep at each hill, near the top of the highest ears. The remainder of the stalks, with the ears, are then allowed to stand in the field until they become dry, sear, and dead; when the ears are husked on the hill, or picked and stored in some building convenient to the corn-crib, and husked as opportunity offers. The fodder remaining in the field after taking off the corn is sometimes cut at the ground, and taken to the barn for feeding to stock; but generally the stock are turned into the field in the bleak days of November and December, to pick off some of the dry leaves and husks, and to trample down the remainder preparatory to ploughing it into the soil. The advantages of this method are supposed to be, that, by drying, binding in bundles, and "housing" these stalks at once, it enables the farmer to secure a portion of the fodder in such admirable condi-

tion, that it is worth more than the whole would be by any other method; that taking off the top-stalks with their leaves "lets the sun's rays down upon the ears, and hastens the ripening of the grain;" and that it takes less labor, and is much less expensive, and easier, than to handle in husking, and cart and store the entire crop. In these claimed advantages there may be a shade of truth; but the objection to the method is, first, it is wasteful. Much more than half of the fodder is at and below the ears; and this, for all judicious, economical feeding-purposes, is practically thrown away. This objection is not answered by saying the cattle can consume what they wish in the field, and valuable use is made of the remainder to enrich the soil; because these stalks — soured, dried, and made brittle and hard by sun and frost, and soaked and washed by rains — can afford little nutriment to the shivering animals, driven by necessity to feed upon them. They will enrich the soil, will exert a most valuable physical influence, especially if ploughed into clayey land; and so would the whole crop. But we cannot afford to grow Indian corn, in the ordinary way, for green-manuring. Economy demands that the whole crop be saved in the best possible condition, used as stock-feed in the barn, and then used to enrich the soil. But the method is also wasteful of grain. Cutting off such a large portion of the active leaves when the corn is quite immature, and letting the sun in, may dry, but cannot ripen, the grain. For this purpose, all the leaves, stalks, and ears should be connected; and it has been found by trial, that, if the stalks are cut at the roots at the proper stage of growth, the elements they contain will be absorbed, and make sounder, heavier, and more perfect grain, than if they were mutilated by cutting off the top. It is admitted that this is the *easiest* method of harvesting; but greater ease would be secured by not harvesting at all, or by not planting. The second objection to it is, that the loss in fodder and grain is not compensated by ease, or the labor saved. At the present time, labor-saving, and labor-saving machinery on the farm, are indispensable to enable us to meet and overcome competition; but to save labor by neglecting to harvest a crop which has intrinsic value, and has already cost us much, is "saving at the spigot, and wasting at the bunghole." Work,

care, and economy, in small things as well as in great, are general essentials for business success; and, if they are ignored, "we cannot afford to grow corn," and may soon reach the condition where we cannot afford to buy it.

Adjourned to evening.

Evening Session.

At the evening session the following lecture was delivered: —

THE SUGARS: THEIR CHEMICAL NATURE AND HISTORY.

ABSTRACT OF LECTURE BY DR. JAMES R. NICHOLS.

The term "sweet" is applied to certain solids and liquids which possess the capability of impressing upon the nerves of taste a peculiar sensation, which is to most people, and especially to children, very agreeable. There is no body or substance which has a distinct physical or chemical property which constitutes sweetness; or, in other words, sweetness as a *thing* does not exist. All we know about it is, that certain molecules of matter grouped in certain forms have the power of producing upon the moist surfaces of the mouth and tongue the agreeable sensation called "sweet." The degree of sweetness is due to the manner in which the molecules are grouped, as intensity or feebleness depends upon the slightest modification in the molecular structure of a body. When the "sweet principle" of plants is spoken of, it is meant that in the sap, with water, are associated some groups of carbon, hydrogen, and oxygen, so arranged as to produce the sensation of sweetness; and by the intensity of the sensation it can be told how they are grouped. Analysis shows the structure of sweet bodies, but nothing more. So far as science is capable of explaining things, it often fails at the most interesting stage of inquiry; and this is the case with sweets. It fails to show why a lump of sugar is sweet, and a drop of vinegar or acetic acid is sour. The point where light ceases to fall upon the pathway of the investigator is that where curiosity and interest most intensely centre. *Why* bodies are sweet, sour, or bitter, can never be known: the mystery belongs to that department of organic life not open

to human research; it is the dark field which has no successful explorers, and is known only to the supreme Intelligence.

The statement that the degree of sweetness in bodies is due to apparently slight modification of molecular constitution is illustrated in a comparison of the chemical structure of several allied substances. In a molecule of cane-sugar we have this grouping, $C_{12}H_{22}O_{11}$; in one of glucose, $C_6H_{12}O_6$; and lactose (the sweet principle in milk) has the same constitution. This affords a view of the molecular structure of the three principal sweets, as known and distinguished, the one from the other, by the distinctive degrees of sweetness each possesses. It will be observed that there is no difference whatever in the nature of the materials or atoms of which they are composed: each is made up of carbon, hydrogen, oxygen, and nothing else. The distinction is manifestly due to the grouping of the same elements in differing proportions, or by different methods. We have in cane-sugar a larger molecule, so to speak, it having nearly double the number of atoms, as compared with grape-sugar, and it holds a maximum of sweetness; but if we had the power of doubling the molecule of grape-sugar, it would not give us cane-sugar. We do not at present possess the power of changing the molecule of grape-sugar over into cane-sugar; and if, in the future, some fortunate chemist discovers a method comparatively easy and costless, he will not only immortalize his name, but realize a fortune greater than that possessed by any living capitalist. The molecule of milk-sugar, so far as chemistry informs us, is constituted exactly like that of grape-sugar: it has the same number of atoms of carbon, hydrogen, and oxygen, and combined after a similar plan; but the two substances are decidedly unlike. They differ not only in degree of sweetness, but also in chemical behavior and physical properties. Grape-sugar is not crystallizable: milk-sugar forms microscopic crystals united in nodules. The solution of the first rotates the plane of polarization feebly towards the right; the latter, decidedly.

Cane-sugar, the noblest and best of all the sweets, is presented to us in the form of aggregated, well-defined crystals, permanent under all atmospheric changes, and elegant in lustre and freedom from color when well refined. It is not only the *sweetest* of the sugars, but one of the indispensable

gifts of a wise Intelligence to man. It is called cane-sugar because it is produced spontaneously and abundantly in the cane grown in tropical climates: but this is not its only source; the sweet juices of the beet, maple, madder-root, and palm, contain it in considerable quantities. Why, in the order of nature, it was necessary to sweeten our grapes and other fruits with a different kind of sugar, is not clearly understood. If it had so happened, that, in the construction of the juice of the sugar-beet, one molecule of water, or the elements constituting water, had been left out, our farmers would never have almost ruined themselves financially by erecting beet-root sugar factories in New England.

It cannot be a mere matter of chance that substances used as foods by men and animals are some of them sweet, and others acid, or that some are sweetened with sucrose (cane-sugar), others with glucose (grape-sugar), and still others with levulose (fruit-sugar). There is a wonderful adaptation of means to ends throughout nature. The sweet sensation is generally agreeable, as has been before stated; but it must be modified and adjusted, else it would become repulsive. If our fruits were all sweetened with pure cane-sugar in differing proportions, they would lack a certain zest due to a peculiar sweetness which they now possess; or, if our grapes did not form an exception to other fruits in the method of sweetening, they would not be the delicious fruit so universally esteemed. Apples, pears, peaches, and most other fruits are sweetened with levulose, or what may be regarded as a mixture of sucrose and glucose; and differing varieties hold unlike proportions, giving, in conjunction with malic acid and certain essences, the nice shades of flavor observed. The manufacture of sugar is not set up in fruits until the period of maturity is nearly or quite reached, and then the process is usually a gradual one.

The grape vine and fruit do not possess the power of grouping the atoms of hydrogen, carbon, and oxygen so as to form molecules of sucrose: the result of their work is confined to glucose. Hence a grape is never excessively sweet, or it does not reach a degree of sweetness beyond what glucose can furnish. If a grape were a solid mass of sugar, it would not be very sweet, as the sugar is incapable of conveying to the taste any intense sensation. Every one who

has tasted old or well-dried raisins has observed the hard lumps of sugar which frequently form, of considerable size, under the skin-covering. These are lumps of glucose which result from the evaporation of the moisture in which it was held in solution in the grape. These lumps are deficient in sweetness, as has been observed from the earliest times. If this substance was supplied in large quantities from grapes or raisins, it would sell at a low price in the market. If a grocer sold it for pure sugar (cane-sugar), it would probably come back to him again, and he would rightfully be charged with fraud. No shrewd dealer or manufacturer would sell it by itself as sugar; but those dishonest in the trade would mix it with cane-sugar, and thus dispose of it with less risk of exciting suspicion. This is now a form of fraud of enormous magnitude, as will be presently shown.

During the wars of Napoleon I., early in the present century, he established the famous Continental blockade by which all products of England and her colonies were excluded from the markets. This, of course, made sugar scarce and dear in France, and stimulated search for products which might be substituted. The grape-crop of France was enormous, and, as commerce was destroyed, it was useless to make wine; so attention was turned to extracting the sweet principle of grapes. Sirups and sugars were made from grape-juice in large quantities; and Napoleon ordered it to be used in the palace, as an encouragement to its production. He issued several decrees in regard to its manufacture; and the celebrated chemists of the time — Proust, Berthollet, Parmentier, and others — were kept busy striving to perfect the products. Montalivet, the great minister of the interior in Napoleon's cabinet, in one of his reports states that it has been ascertained that the grape-sugar equivalent of cane is a little over two and one-half to one. This is not far from correct.

Thus it is shown that the chemists of France were making glucose more than seventy years ago from grapes; and, if they had known that it could be made as well from potatoes, corn, or any other cheap substance holding starch, the discovery might have retarded the great progress that soon followed in producing cane-sugar from beet-juice.

It was as early as 1747 that Margraff made his experi-

ments showing that beets contained sugar; but it was not until Achard, the son of a French refugee in Prussia, took up the subject, and published the astonishing results of his researches, that it excited public attention. The difference between the two forms of sugar — that from grapes and that from beets — was easily seen; and Napoleon's attention was called to it by his corps of illustrious chemists. He immediately gave himself to the work of creating and perfecting this new industry; and in 1812 he had the satisfaction of learning from the reports of his minister of the interior that 334 factories in the empire were producing annually 7,700,000 pounds of beautiful cane-sugar from beets. This seems almost like the work of magic, and illustrates the greatness of the man whose power was felt in every part of the civilized world.

The early attempts to extract sugar from beets in Napoleon's time were made subjects for fun and ridicule. The emperor himself did not escape the lampoons of the wits of the age. A caricature was exhibited in Paris, in which the emperor and the baby king of Rome were the prominent characters. The emperor was represented as sitting in the nursery with a cup of coffee before him, into which he was squeezing a beet-root. Near him was seated the King of Rome voraciously sucking a beet-root; while the nurse, standing near and steadfastly observing, is made to say to the youthful monarch, "*Suck*, dear, *suck:* your father *says* it is sugar."

In manufacturing glucose from corn, the process is, first, to separate the starch from the other constituents of the grain, by simple mechanical means; and then, secondly, to act upon the starch with dilute sulphuric acid (oil of vitriol). When thick gelatinous starch is boiled for a couple of hours with this acid, a curious transformation takes place: the milky paste first changes to a fluid as limpid as water; and, as the change advances, this acquires a sweet taste, which is masked by the presence of the acid. If we now saturate the solution with some earthy carbonate, marble-dust for instance (carbonate of lime), the acid is removed, and a sweet solution remains, which, after purification, may be evaporated to a sirupy liquid, or, by still further manipulation, converted into a white solid, which is grape-sugar.

This is the whole process for making "sugar out of corn;" and it is simple enough. In this chemical transformation nothing is absorbed from the air, and no other substances but dextrine and grape-sugar are generated, and the weight of the sugar exceeds that of the starch employed. What is still more wonderful, the acid used undergoes neither change nor diminution: it is all withdrawn in its original amount after the boiling is completed. If it could be withdrawn in its clear, uncombined state, one carboy of oil of vitriol would serve to change all the corn grown in the United States into grape-sugar. Theoretically one pound of corn ought to make a pound of solid glucose, but in practice it does not quite do this. The cost of solid glucose to large manufacturers cannot exceed three cents a pound, and it may fall considerably below this.

Nothing can be more paradoxical to the popular reader than the statement that sugar is produced by the use of one of the most powerful mineral acids known to chemists. To explain clearly and fully the chemistry of the reactions involved in the process would require more space than we have at command; and also, to understand the nature of the changes, more scientific knowledge would be required than is possessed by ordinary readers.

Glucose is a cheap, imperfect substitute for the genuine sugar of commerce. It is not a poison when well made; and, as regards its healthfulness, it may not be much more deleterious than ordinary cane-sugar. Still, it does produce and aggravate dyspeptic symptoms; and, by its proneness to set up fermentative processes, its use causes flatulency, and painful affections of the bowels.

What becomes of the millions of pounds of glucose manufactured in the Western States every month? It is used mostly as an *adulterant* in the manufacture of table sirups, and in adulterating the dark, moist sugars used largely by the poor. Its next largest use is in the manufacture of candies. All soft candies, waxes, taffies, caramels, chocolates, etc., are made of glucose. Children are therefore large consumers of this substance. The honey-bees, also, are fond of it, and will carry it away by the ton, if placed within their reach. The honey made from it is no better than the pure glucose, as it is stowed away in the comb without change. Human ingenuity, it is stated, has reached

the point of making honey, and storing it *in the comb*, without the mediation of the bee: therefore we can now dispense with its services. By appropriate machinery a nice-looking comb is made out of paraffine, the cells being filled with glucose-sirup; and this factitious honey is warranted true white-clover honey from Vermont.

The beautiful clear white sirups found on our breakfast-tables, and used as an agreeable adjunct to our waffles and buckwheats, are largely composed of glucose. A mixture of true "sugarhouse" sirup with glucose-sirup, in proportions of five or ten per cent of the former to ninety or ninety-five per cent of the latter, constitutes the high-priced "maple-drip" of the grocers. A Western chemist reports the results of recent analyses, in which adulterations amounting to from five to fifteen per cent of glucose were found in various popular brands of sugars.

In this brief consideration of the nature and uses of a comparatively new article of manufacture, the astonishing fact is disclosed, that this year more than twelve million bushels of corn have been manipulated to produce an article employed almost exclusively as an *adulterant* to one of the most common and important constituents of food. It is a reprehensible form of fraud, and should be arrested by laws similar to those which govern the sale of the "oleomargarine" compounds. Every package of this sugar should be stamped *glucose*, and sold as such; and every mixture made with it should be accompanied with a statement, stamped upon the vessels which hold it, giving the exact percentage of glucose contained in the adulterated sugar or sirup. A law similar to that which is found on our statute books, regulating the sale of fertilizing compounds, would be effective, if energetically enforced. The loss to purchasers in the glucose-sirups is enormous, as the quantity required to sweeten substances is at least twice as great as when cane-sugar is employed; and the use of this quantity of the agent renders it deleterious to health. The attractive appearance of the sirups, which are white and clear, gives them a wide sale at high prices; and all consumers of sweets in the country are victims to a form of fraud which deserves the prompt attention of our law-makers.

The Board adjourned to Wednesday morning.

SECOND DAY.

WEDNESDAY, Dec. 7, 1881.

The meeting was called to order at ten o'clock by Mr. LANE, who introduced as the chairman for the day Dr. HORACE P. WAKEFIELD, who, on taking the chair, expressed his thanks for the honor conferred upon him, and further said, —

"Now I have the pleasure of announcing that we are going to hear something from a gentleman who lives in that region where 'the shot was fired' that was 'heard round the world.' He is going to tell us something which is worth knowing, and which the whole world should know. I introduce to you Mr. J. B. MOORE of Concord, who will speak to you on 'The Management of Cultivated Mowing-Lands;' and if there is anybody, in my opinion, in the Commonwealth of Massachusetts, who understands the subject, it is Capt. Moore. He needs no introduction, because everybody who has ever had any thing to do with agriculture knows him."

THE MANAGEMENT OF CULTIVATED MOWING-LANDS.

BY JOHN B. MOORE.

The subject assigned for me to speak on this morning — "The Management of Cultivated Mowing-Lands" — I need not say to you is a very important subject; the most important, in relation to the system of the agriculture of Massachusetts, as judged from the census. In money value, the hay-crop far exceeds any other crop grown in the State. The value of the crop of English hay, according to the census of 1875, was $9,106,159, being more than one-fourth of the entire agricultural products of the State. The crops of barley, beets, buckwheat, carrots, Indian corn, clover-hay, meadow-hay, millet, salt-hay, oats, onions, parsnips, potatoes, rye, tobacco, and wheat, amount to $7,200,000, — $2,000,000 less than the value of the crop of English hay alone; so that you will see, although it was said yesterday in a paper that corn was king, that corn has a low position in this State when compared with English hay. The value of the corn-crop of Massachusetts is a little more than $1,000,000. The

hay-crop is not a local interest: it is the same from Berkshire to Essex; the same from Worcester to Plymouth; the same, in fact, in all parts of the State. It is not a local interest, as market-gardening and some other interests might be termed; and therefore I may well say to you that it is the foundation of Massachusetts farming. It means sustenance for our cattle; it means milk, butter, cheese, beef, and pork; and it means manure with which to grow the other crops. I think those propositions are all right, — it means all those things. The census of Massachusetts shows an average crop of one ton only to the acre, and the value of that ton of English hay in 1875 was $17.30. Assume, then, that five years is the usual length of time which a piece of land lies in mowing (I mean, gentlemen, without renewing); and, as I have reckoned the cost of growing an average crop, it would be about as follows, under the common method of treatment adopted by the farmers throughout the State. Of course, the statement that I am about to give you may be criticised: some things may be a little too much, and some not enough. But assuming that the labor in ploughing, harrowing, rolling, and sowing the seed, is $6 an acre, the average value of the manure that would be applied to the acre may be reckoned at $25 (supposing that the land is to be seeded at once). The amount of seed that I sow on an acre of land is worth about $2. I also assume that the average top-dressing would be once in the five years, and that would be worth $20 more. Then the harvesting of the five tons of hay five separate years would be worth about $4 a ton, which would amount to $20 more. The total of that is $73.

The average value of a ton of English hay is, as I have said, $17.30. The average cost of growing that ton, if the statement that I have referred to is anywhere near correct, is $14.60; and that leaves $2.70 with which to pay the interest on the money, the taxes, and the fencing. I have given you the averages. You will see that the chances of accumulating money under that system are pretty small, — not so brilliant as you would like to see them.

Now, are you satisfied with any such result as that? I know that the farmers who gather at these meetings are intelligent and progressive men. Those whom I see before me are far above the average intelligence of the State; and I

am sure that you cannot be satisfied with any such result. Remember, also, that, to make even this poor showing, many acres of grassland, producing from three to five tons of hay per acre, are reckoned in; so that you can see that some of those acres have got to average very low. You will all agree with me that it is desirable to increase this crop. There will be no difference of opinion, certainly, about that.

Now, what would be a satisfactory crop throughout the State? No matter what amount we get to the acre, we would be better satisfied if we got a little more, but I assume that three tons to the acre would be a satisfactory crop; that is, two tons to the first crop, and one ton to the second, with a reasonable chance of getting more than that the first two or three years after the land is newly seeded.

To accomplish that, high cultivation is necessary. High cultivation is true economy, and should result in not less than three tons to the acre on good grassland. I have used the term "good grassland;" but perhaps, to talk understandingly about this matter, I ought to give you my idea of what good grassland is. I assume that any land in Massachusetts, with reasonably good soil, — that is, not dry enough to suffer from a light drought, not wet enough to grow the wild grasses and rushes, — is good grassland. How should such land as that be made to produce better crops? Let me say, before I go into that, that some of the grasslands in the State are undoubtedly lands that have been naturally too wet to produce grass; but, by draining, the water has been taken off, and more room given for the extension of the roots by the very fact of lowering the water-table, and this draining has, with proper cultivation, exterminated the water-grasses. You have, then, a soil that is as good as any, to produce grass on. You have made a new piece of land of it: you have taken a worthless piece of land, and, by draining and a little manuring, you have made it good mowing-land. Now, how should it be managed to produce better crops? I have about twenty-five acres of grassland. Some of you will say to me, "Well, you have got better grassland than some other people." I allude to that, because that remark has been made to me often. When my father bought the farm which I now occupy, a ton of English hay was not produced on the place; and the grassland that I use now

is not the best land I have, because I have to take a large number of acres of the best land on my place to grow something else; but nevertheless it is what I call reasonably good grassland. Now, how should it be managed? I do not like to seed any grassland down in the spring: therefore, if I have any crop on a piece of land that I can get off early in the season, I plough that, and seed it with grass; or, if it is already in sod, then I prefer to plough it some time early in August, and after ploughing, turning it over carefully, I put on about thirty-five dollars' worth of manure to the acre. When I say thirty-five dollars' worth of manure, you will ask me how many cords? I cannot tell you exactly; but it means on my place about thirty-five one-horse cartloads of manure, such as we gather from the barn-cellar, in the pig-pen, and the yard. There is more or less loam in it, or some absorbent; but there is no more absorbent used in the manure on my place than is necessary to take up the liquids. I do not believe in carting your farm into the barn-cellar, and imagining that you have made it into manure, and then carting it out again: I do not believe that is economy or policy. So it gets thirty-five one-horse cartloads of manure to the acre, or that is the intention, — it might fall short one or two loads, or it might overrun one or two loads, but that is the intention, — that it shall have thirty-five one-horse cartloads to the acre. After it is spread upon the land — if you do not use one of those wagons which spreads as it goes along, which I have not used yet, although some of them do the work well — after it is spread, we go over that piece of ground each way with a disk harrow. We prefer that to the others; because, where there are no stones or other obstructions, it makes a piece of ground most like an old field.

QUESTION. Do you put it in heaps before you spread it? or do you spread it from the cart?

Capt. MOORE. We spread it usually from heaps, because it is more expeditious. If you are going to put on fifteen or twenty loads to the acre, you had better spread it from the cart; but if you put on enough, so that you can see it all over the field, you can spread it reasonably well from heaps by looking after the men a little. They will leave a little at the bottom of the heap, if you do not look after them. If they do, you must make some remarks to them to the point.

Where there is less than fifteen loads to the acre, it is not easy to spread it reasonably well, even from heaps; but, where there is quite a quantity, I do not find any difficulty. Then we go over the ground with a harrow each way: the effect of that is to make the ground even. Now, this disk harrow does not leave the surface of the land in a suitable condition to receive grass-seed: therefore we put on what we call a Scotch harrow, — a square harrow, with a joint in the middle; but any harrow will answer the same purpose, only that is made with steel teeth, small and fine, and leaves the ground not quite so fine as the Thomas smoothing-harrow, but sufficiently fine. Then I sow my seed. Now, gentlemen, I know something of what I am talking about; for I want to tell you, that, for more than forty years, there has not been a peck of grass-seed sown on my farm that I have not sown with my own hands. I sow the seed, and give directions, and do some of the other work. I am getting a little lazy, and don't do as much work as I used to; but I know how the work should be done to suit myself, and I try to have it done that way. I am particular, when that piece of ground is seeded, that it shall be level. I am very particular that no piece of land that I seed down shall have depressions in it to hold water, that will freeze in the winter, and kill the grass. My land is naturally quite level; and within the last two years, although the soil is not very gravelly, I have worn out a good iron scraper in simply grading up low places, and now I have got land that you can go over after a heavy rain and not see a puddle, and still there is none of it steep enough to wash. I use a swivel-plough always on the grassland that I am going to seed. If you have a piece of land that you are going to plough and plant a year or two, it is not so important to use a swivel-plough, because you can turn it the other way, and fill up the dead furrows afterwards; but you can use a swivel-plough to a great deal better advantage on your grassland.

I sow a peck and a half of herd's-grass and one bushel of red-top to the acre. I have sown half a bushel of herd's-grass, and various quantities; but I have returned to my rule as being the best for my purposes. I do not say, gentlemen, that it is the best for yours. I have sown a half-bushel of herd's-grass to the acre, and have had my grass thicker than I

wanted it. I like to have plenty of substance, so that it will not fall down at the first rain in the spring.

QUESTION. Do you sow any clover-seed with it?

Capt. MOORE. I do not sow any clover-seed; because, if I wanted clover, I should sow it by itself. Clover does not ripen at the same time with herd's-grass and red-top. I do not think it is economy to mix clover with those seeds. I use my hay in this way. Five or six years ago I made it all into milk; but the milk business of late has been very unsatisfactory. I am going to make milk for the Boston market whenever I can get a fair price for it; when I cannot, I am not going to make it. I once belonged, as many of you have I suppose, to the Milk Producers' Association. I saw that they could not accomplish any thing under the methods which they followed; and therefore I withdrew from the association, and made up my mind, that, if I could not sell my hay through selling milk at a fair rate, then I would sell it some other way. I could not get horses to keep to use up the hay; but I found that I could do this, — I found, that, by raising hay of far better quality than the average, I could sell it for more than the market price, and I could buy manure; and I can certainly net more by selling my hay, and buying manure, than I can by making milk. Perhaps all of you cannot do that.

QUESTION. What do you call a fair price for milk?

Capt. MOORE. Every farmer who sells his milk for the Boston market ought to get five cents a quart at his door for it. That is only a fair price. You could not do as the manufacturer of cotton cloth does: you could not buy your cows, buy your hay and your grain, calling your cows your machines, and your hay your cotton or other material, and work it up into milk, and live on it at five cents a quart. The loss is too much on the cattle that represent the machinery.

Mr. TAFT. If you buy every thing.

Capt. MOORE. If you buy every thing, you cannot do it at that price.

Having sowed the seed, I have sometimes simply covered it by rolling: again, I have thought that it was a better way to run an ordinary brush-harrow over it, — it takes but a few minutes for an acre, — using a harrow ten feet wide, with a

sweep around each side. Then I usually roll it, to make it a little more smooth. One of these levellers amounts to the same thing as a roller, and does the work just as well, except, if you have a piece of ground that has cracked open in the spring, and you want to close it up, you cannot do it so well with the leveller as you can with a roller. But there is one advantage in a leveller: you can house it by setting it up edgewise, whereas a roller takes up as much room as a wagon.

I want to sow my grass-seed some time between the 15th of August and the 20th of September. Suppose, in the latter part of August, that the top of the ground was extremely dry, and you were all ready to sow: I would not sow it, because some portions of that ground would be moist enough to sprout the seed; and, if the dry weather held two or three days after it was sprouted, it would kill it. You had better wait until after a rain: you cannot get a good growth without moisture. You can sow later than the 20th of September, if the ground is exceedingly rich, or if there is a great deal of manure put on; but in the ordinary method of manuring, and with the ordinary seasons, in which we are liable not to have very much growing-weather after that time, it is better not to sow it later. Therefore, if I am unable to complete what I wish to do, so that I cannot seed early enough, I prepare the ground as I have described, and seed it just before winter closes. If I seed it before winter closes, I am very careful to cover it with a brush-harrow, and put on neither the roller nor the drag.

Now, you might ask me why? Because, if you roll a piece of land just before winter, and it is not covered with grass to protect it, or if you smooth it with a drag, you will notice, that, the first wind that comes after it gets dry, the dust is going off of that piece pretty lively. If you simply cover it with a brush-harrow, which leaves a slightly rough surface, the wind does not have that effect upon it, and it goes through the winter better than it does if it is rolled. That is the only reason why I do not roll it then; and usually there is no necessity, on my land, of rolling in the spring, unless on one piece, where there is more or less clay in the soil. If a good sod has not been formed, it is desirable to run a roller over it early in the spring, to close up the cracks in the ground.

QUESTION. Do you ever sow grass-seed on the snow?

Capt. MOORE. I have sown clover on the snow, and I have sown grass-seed on the snow, very early in the spring. The difference between sowing grass-seed extremely early in the spring and in the fall is this: Sown in the fall, the warm weather will start the seed, and it grows quickly; if sown in the spring, it does not come up so quick by at least ten days as when sown in the fall, and then you give the weeds a chance to start, and you have to head off the weeds. If the grass-seed is sown in the fall, the weeds do not start until it is a little warmer than is required to start the grass, and you do not have so many weeds. The difficulty in sowing early in the spring, without any grain with the grass-seed, is the trouble with the weeds. Now, if some of you have a very wet piece of ground, and you sow it in the fall, you will have some weeds the next year. I have grown some excellent crops of weeds; but I figured up those crops of weeds some years ago, and I calculated they were the most unprofitable crops I ever grew. I would not advise you to go into growing crops of weeds. The one great difficulty with young men, when they start in farming, is, that their eyes are so big, they want to plant all the ground in the spring that they can, and they think they are going to hoe it; but, by the time they get into the middle of July, it is all overrun with weeds. If there is any one thing I would say to them more emphatically than another, it is this: You had better start with a less number of acres, and take care of them.

In the course that I have undertaken to lay down here, I do not propose to use any compost-manure during the five years. I know that some of you will disagree with that. I mean, I do not propose to use any top-dressing, which is usually done with compost-manure. I do not think it is economy to top-dress your grassland. It will not do for me to say here that it is not economy, unless I tell you why I think it is not. I do not mean to have you understand me to say that top-dressing a piece of grassland will not make more grass, because it will. I can imagine a piece of land so situated that it might be economy to top-dress it, but it is not economy for me to top-dress mine. I have to use a great deal of manure for other crops, and what manure I

can get I want to put on when I seed the land down. I have used thirty-five loads to the acre; and, if I had manure enough for a good deal more than that, I should put it on. I want to use all the manure that I can get on the farm for seeding every year; and I want to use it at that time, because I want to put it where it will do the most good. I want to put this manure where I am going to get the most grass from it: therefore I want to put it on at the outset of the course, because at that time I have sown the seed. I am starting with new seed for a new crop (no wild stuff in my way); and I want to make some big crops the first two or three years in the course, and therefore I want that manure, as I said, in the outset of the course. I am going to start new, vigorous plants, and I want to use it to the best advantage; and I think I do it in that way.

I do not want you to understand that I am going to run that piece of land five years without any thing else, because I do not propose to do any thing of that kind. The first year, with that manure, I take off my two crops. You may say, "If it is dry weather, you are not going to get your two crops." Dry weather has nothing to do with it. If you have good cultivation you will get your two crops: I do not care whether it is dry or wet. I have laid out for them, and I have got them; and I think any of you can, on such land as I have described. If you sow a piece of land that is extremely dry, and which will be all burnt up with drought, you cannot get the two crops.

The spring of the second year, very early, I want to top-dress with a fertilizer. There are some distributers now made that can be attached to a horse-rake; and I can go over a piece of ground and distribute a fertilizer as quickly as you can rake an acre with a horse-rake, so that the cost of putting it on is not much. I want to put on five hundred pounds of ground bone. I do not care about the bone being dissolved; because, if you put it on your land, it is something that you are not going to lose: you are going to get the benefit of it. At the time I put that on, I put on two hundred pounds of muriate of potash to the acre. There may be a great deal better combinations. I presume that Dr. Nichols knows of great deal better combinations; but on my land that does better than any thing I know of. I am

not a chemist, and I have to get my information in regard to all these things from actual trial; and, if the application of a particular fertilizer satisfies me that it is paying, I am satisfied with that.

Under the course I have described, I do not find any trouble in getting two crops averaging about three tons to the acre. I am not satisfied with that. I am going to have more, in some way or other. I think I can get it with increased amount of manure. Under my method of cultivation the expense is as follows: —

The labor of ploughing, harrowing, and sowing, is precisely the same as under the common method, $6; manure, $35; the bone and potash, four years, $14 a year, would be $56; the harvesting, five years, two crops a year, $4 each time, would be $40: that would be $137.

The average crop for the five years, taking the average price of the three tons at $17.30, would be $51.90; the average cost under that system per year would be $27.40: that would leave you $24.50 with which to pay your taxes, fencing, and the interest on the money.

I can easily see that some of you will say, He has not allowed any thing for carting that extra ten tons of hay in the five years. That is true: that came into my mind; but you have left the land in enough better condition to pay for carting that hay three or four times over. If you have given it that amount of manure, ground bone, and eight hundred pounds of muriate of potash, in the four years, you have left that land better than it was when you started. I do not think any of you can dispute that.

There is another element of compensation which I have not mentioned, — from high cultivation. I have told you that the average price of a ton of hay is $17.30. The average price of a ton of hay grown under high cultivation is more than that. Some of you will say, If you grow hay thin, it matures better; but do you understand, that, if you grow your hay thin, and leave any vacant spaces, they are to be occupied by weeds and wild grasses, and your hay is not worth so much per ton, and will not average as much? You actually do not get so much hay, and it is not so good as it would be if grown the other way. At any rate, my cattle do not like it as well, and it will not bring so much money.

Now, in regard to the cutting of the hay. What is the object of cutting hay? Why, it is simply for the purpose of drying it, and storing it conveniently, in a sound condition, for the purpose of feeding it out to the cattle, which we are obliged to keep in the barn six months in the year. That is really the object of making hay. Now, in regard to the cutting. I do not expect that half of you are going to agree with me. I believe in cutting hay early. I am speaking of Timothy and red-top. The best way to cut that hay for all purposes is when it is not quite fully in blossom, — I do not want to have it get fully in blossom, — and there are some reasons why it should be cut then. Grass is perhaps the best food to grow cattle, horses, and sheep; and the nearer you can keep your hay to the form of grass, the better. I understand that many men who keep horses, particularly fast horses, want to have their hay cut later. We do not care any thing about fast horses: we are satisfied with any thing that will go about twelve miles an hour when we are out. We do not care any thing about speed: we only want something that we can get around and do our work with comfortably, and go to mill and meeting, etc. Now, the reasons why you should cut it early are, in the first place, that it will make more milk, if you propose to make milk; it will make more and better butter; cattle will grow better on it, and eat it cleaner. The same is true of sheep and horses. Some will say it is not woody enough for horses; but I had rather have my horses eat hay made from succulent grass than to load them up with wood inside.

Chemists will tell you that there is actually more nutriment in the grass after the seed is nearly matured. I presume my friends Dr. Nichols and Dr. Goessmann will say the same thing; but cows, and the other stock that it is fed to, will prove to you that it is better cut early: so you have got your cows on one side, and the chemists on the other. Well, they are both right; that is the beauty of it; and I think that is easily explained. The chemist, by the powerful solvents that he uses in his analyses, will show you that there is a certain amount of nutriment in that food. Well, you can put a cow to eating it, and she will say that that food is not as good as the other; that the early cut, tender hay is the best, and probably for the reason that she can more readily

assimilate one than the other. They may both be right; but I am going to stand by the cow in this matter. They are both right; and the variation in testimony is simply because the cow, or other animal, can digest that food, and get the benefit of it in that condition, better than it can in a ripe condition.

Then, there is another point. You do not exhaust either the soil or the plant so much by cutting it early as by cutting it when it is fully matured. The exhaustion of the plant comes largely from the maturing of the seed. I do not think there will be any dispute about that. If you allow the crop to seed, you may perhaps get a little more in your first crop; but your second crop is lost, because you have allowed the plant to become exhausted, so that it starts feebly; and after you get along later in the season, when we are liable to have dry weather, you do not get so good a second crop.

There is still another thing about it. Timothy holds in better when cut early than it does when allowed to ripen. There is another great objection to cutting this hay late, particularly with those who use the mowing-machine, because they are inclined to cut down about as near the ground as they can. They cut some of the Timothy so near the ground, that, if it is a dry time, and followed by a few days of dry weather, the little bulb at the root of the grass, which Timothy has, is killed outright. I have seen large pieces ruined simply by close cutting; and the farmer has simply saved an inch or two of wood at the bottom of the plant, and ruined his grass by the economy. I have suffered in that way, because my men set the mowing-machine too close to the ground. I think it should be set so as to cut the grass three inches high. That may be higher than some of you would put it, but I think it ought to be set three inches high. And in cutting rowen, it is very desirable, for the benefit of mowing-lands, that it should be cut by the 10th of September. You want to leave time for the grass to grow, to make some little covering for the ground before winter, and you get better weather. As a rule, it is better to cut by that time than to allow it to grow longer. Now, many farmers, particularly those who manage their farms under the old system (they used to do it when I was a

younger man), believe, that, in preparing a piece of land for grass, the first thing to be done is to plant it with corn and potatoes from one to three years, and exhaust it, and then seed it down with the expectation of getting a crop of grass. That is done to a considerable extent yet. I have no objection to raising crops of corn and potatoes, and all that; but, when you have planted your ground two years, you have largely used up the benefit of the rotting sod that you have turned over in those crops, and you must compensate the soil with something to make that good. You have not properly prepared it for the grass-crop, unless you have put on more manure than your crops have taken off; rather than that, you have used up the sods, which would be a great benefit in growing grass.

A good way for a farmer to do with his land, who has not grass enough to keep his cattle in the winter, is to take a piece of this grassland, that perhaps has run down so that it will produce only from eight hundred to a thousand pounds to the acre, mow that early (by the 10th of June), plough it, turn it over handsomely, — don't half do it, make a good job of it, — pulverize it in the way I have described, and, if you have not manure to put on it, put on a ton of ground bone, undissolved, to the acre, simply fine ground bone (of course you will say that you are not going to get the benefit of a portion of that bone for some time, and that is true), then sow it with millet. You will get fertilizer enough to raise a big crop of millet (I know, because I have not only done it myself, but I have seen it done by some of my neighbors at my suggestion), — you will get a large crop of millet, perhaps three or four tons to the acre. You will get that crop by the middle of August, or before the 1st of September. Then put on the disk harrow, and stir the ground up (there will be no weeds, the millet will keep every thing down), and then sow grass-seed, and you have prepared that land so that it will produce good crops of grass for five years, perhaps not three tons to the acre; but it will give fair crops of grass.

I would like to say one thing further. In my judgment, there should be no feeding on your grassland. I do not allow a cow to go on to my mowing, or any other animal whatever. If you must take that grass off to give to your cows, mow some of your later rowen, and feed it to them green: but do

not let them go on the land, and trample it down. If you do, you not only injure the grass itself, but you waste your food to some extent. It is a great deal better to cut it, and feed it to them. Only the day before yesterday I saw cattle running all over some wet mowing-land. I am very sure that the farmer who owns that land is not here in this audience. Nobody here would do such a thing.

I do not know that I have much more to say about the grass-crop; but I would like to remind you of what Swift says, — the old thing that you have heard so many times. He gave it as his opinion, that "whoever would make two ears of corn or two blades of grass grow upon a spot of ground where only one grew before would deserve better of mankind, and do more essential service to his country, than the whole race of politicians put together."

QUESTION. When you have got your ground ready to seed to grass, and have not got thirty-five loads of manure to use, and find you have got to use something else, what would you do?

Capt. MOORE. I generally contrive to have it.

Mr. SLADE. You are talking to somebody, perhaps, who hasn't it. I haven't it myself to spare.

Mr. TAFT. You live within twelve miles of Boston, and you can get all the manure you want. Now, Mr. Slade lives where he cannot get it. I live twelve miles from any city. I have not the manure to put on. Now, what shall I put on?

Capt. MOORE. I want you to understand, in the first place, that I do not live within twelve miles of Boston: it is seventeen miles. In the next place, I do not see why you cannot get manure just as easily as I can. As far as Mr. Slade is concerned, he goes to Fall River, and gets manure cheaper than I do.

Mr. TAFT. The Boston and Albany Railroad won't carry it to Milford for what it is worth, and then I have to draw it six miles farther.

Capt. MOORE. I will tell you what some of my neighbors have done. One man, who is only separated from me by the road, has certainly raised some good crops of grass with four or five hundred pounds of some phosphate; but he has let his land run back. He is one of the men, who, having got a good crop, expect that it is going to last them forever. But if

you put on a phosphate, it is generally used up the first year. You cannot keep on growing crops without compensating for them. What you want to find out is the cheapest way in which you can make that compensation. I do not know what is the best thing for you to do; but I have told you what will grow millet on poor land, and grass afterwards. I think of all the concentrated manures that you can use, if you can buy it in a cheap form, bone is the best. I think you want a little potash. I have bought sulphate of ammonia, and all that sort of thing, to get nitrogen; and I do not believe I shall invest much in nitrogenous compounds at present.

QUESTION. What would be the value of ashes, compared with bone at the price it is selling?

Capt. MOORE. Ashes are a very valuable manure, but I cannot get them. I would rather have plenty of good wood-ashes than muriate of potash; because, I think, in the form of wood-ashes the plants get hold of it, perhaps, more readily.

Mr. TAFT. What can you afford to pay a bushel for good wood-ashes, if you can buy them?

Capt. MOORE. That is a good deal like asking me how big a piece of chalk is. Ashes vary greatly in value, containing from a pound and a half to five pounds of potash to the bushel. The Canada folks offer to sell good hard-wood ashes by the carload, delivered at our depot, which they say analyze five pounds of potash to the bushel (I do not know whether they do, or not), for thirty-two or thirty-three cents.

QUESTION. Why is it not as well to buy potash, and use that, instead of carting ashes?

Capt. MOORE. Dry ashes are not very troublesome to cart, nor are they dear at thirty-two or thirty-three cents a bushel. In the ashes you are getting a little phosphate of lime; but it is mostly potash: you do not get bone enough. There is the great trouble that farmers have, — they resort to one thing, and expect it to do every thing for them.

Dr. NICHOLS. I would say, in relation to this matter of the value of ashes, that I purchased a carload of Canada ashes in November; and, after making an analysis, I found they gave me about five pounds of potash to the bushel. They cost me, at Haverhill, thirty-four cents a bushel. I think that we lose sight of one point, in our estimation of the value of ashes. The value of ashes is not entirely con-

fined to their alkaline constituents. We usually estimate the potash, without taking much account of the soda. We must remember that there is a trace of soda running through; but it is so small, that we generally say but little about that, and estimate it all as potash. In ashes we get soluble phosphoric acid, and we get soluble silica, which I think is a very important agent. These ashes come from burnt vegetation; and you are simply putting back on the land all those constituents which the land requires. You get in those ashes precisely what your plants want in the form of soluble silica and phosphoric acid; and especially largely predominating over every thing else is the element of potash. I think we have under-estimated the value of potash on our lands. The mistake has arisen, in great measure, from the fact that we have been looking to the results of English analyses. I have found that in England they do not think very much of potash, and do not speak of it with very much emphasis; but on the other hand, so far as my experience goes, it seems to me that potash on our land is very important indeed. I fully coincide with the views advanced here by Mr. Moore with reference to the use of potash with bone. I have found extraordinary good results from that combination. I think if you can get Canada ashes, and mix them with bone in the proportion of two or three barrels of ashes to one of raw ground bone, and allow the mixture to ferment a little, mixing in with it a small portion of sulphate of lime (common gypsum), you will make a fertilizer which is unequalled in value; and it is very simple. I remember recommending bone and ashes at a meeting of this Board a few years ago; and I come back to that again with a great deal of pleasure. I have plots of land in my fields which have not been manured for fifteen years; and my men inquire of me, "How does it happen that we are getting such crops of grass here, without putting on any manure?" I am free to say that it astonishes me, — the persistency with which bones will give us continuous crops, especially in association with wood-ashes.

QUESTION. Will not salt do as well as gypsum?

DR. NICHOLS. Oh, no! I do not think that I can safely recommend salt. I do not think that we receive any benefit from salt: on the other hand, I think we receive injury from

it. I do not believe that salt, as a manurial agent, should enter into our category of substances to be used on our farms. I have reached that result after twenty years' experience.

QUESTION. I would like to ask Capt. Moore, if, in his opinion, it can be made profitable, upon good grassland (such land as he has described), for a man to buy any kind of commercial fertilizer that is now offered in market, at present prices, to grow grass.

Capt. MOORE. I do not want to judge of fertilizers in the market. I have told you that I thought it was desirable to use potash in some form. If you cannot get wood-ashes, use muriate of potash, and use bone, for the purpose of growing grass. I have answered the question as far as that. I have told you that I believe that it is desirable, instead of using a top-dressing of compost-manure, to use a certain quantity of bone and ashes, or bone and potash. I know very well (for I have done it a great many times) how valuable ashes are for breaking down bone, as recommended by Dr. Nichols; but I am in this trouble, — that I cannot get the ashes. Perhaps I can now, by buying the Canada ashes. I think Dr. Nichols has told you of a better preparation and a safer preparation for you to use than these fertilizers; but still, as I have said before, I have seen three or four hundred pounds of superphosphate applied to an acre, and a good crop of grass grown the next year from it.

QUESTION. I would like to ask if you think it profitable to confine yourself to two varieties of seed; and whether it would not be fully as profitable to use more varieties, provided they ripen about the same time.

Capt. MOORE. I expected to be asked that question. As I said to the audience, I use Timothy, or, as it is usually called, herd's-grass, and red-top, because I think those varieties mature nearly at the same time, and are better adapted, not only for purposes of feeding, but to sell, if I cannot get a fair price for my milk; and I think they will produce more. If you sow orchard-grass, you want to sow it alone. If you sow Kentucky blue-grass, there is not enough of it, at least not with me; and I prefer those two grasses. If I am going to grow clover, I will grow clover; but I do not want it mixed with the other seed. There will be some in it, in spite of all I can do; but I do not propose to sow it.

Mr. ——. I have had a little experience, which I will relate (perhaps experience is as good as any thing): Year before last I planted, for the first time, orchard-grass with clover. We had a most remarkable drought in Kingston, and the herd's-grass was entirely killed, and a great portion of the clover; but the orchard-grass stood the drought when other things did not. I found that it ripened exactly with the clover. I would like to hear the experience of others, because it takes more than one swallow to make a summer. I was very much pleased and struck with the appearance of the orchard-grass and clover both ripening together. I know there is a trouble with clover, — that other grass is killed out; but it appears that we have got something that will work with clover in the orchard-grass, and something that is capable of standing a severe drought.

QUESTION. I would like to ask Capt. Moore how unleached ashes compare in value with leached.

Capt. MOORE. I cannot tell you. I know leached ashes is a good thing to have; but about the only difference between leached and unleached ashes, as I understand it, is, that one has had the potash largely extracted, and the other has not. In buying leached ashes, it takes about a bushel and a half of dry ashes to make one bushel of leached. If you get it from soap-makers, lime and some other things have been added.

QUESTION. I should like to ask, if, under the system of top-dressing which you recommend, the land will hold out longer than five years; that is, bear paying crops.

Capt. MOORE. Perhaps I ought to have touched upon that point. I think when you have cut your plants five years, getting two crops a year, it is better for you to turn that sod over, and start again with new plants.

QUESTION. Will the gentleman tell us how large his last crop is, in proportion to the others, — how much his tenth crop is reduced?

Capt. MOORE. If I had a piece of land from which I did not get but three tons to the acre, I should want to begin to plough. Three tons are not going to satisfy me. If you got three tons the fifth year, that would represent five tons the first year.

QUESTION. It seems that the captain has been telling us

his experience on what he called good grassland; but he has not told us what kind of land it is. I have noticed that grassland sometimes varies very much in subsoil, and I would like to know what his subsoil is.

Capt. MOORE. I thought I explained very clearly what I thought good grassland was. I simply said that I regard any land on which the grass-roots will not dry up in a light drought — and of reasonably good soil that has been drained if it has been at all wet, and is not so wet as to produce sour grasses and rushes — as good grassland. I took a piece of land last year that was never ploughed: some of it was a black soil, underlaid with whitish sand in some spots; some of it ran down into peat; and some of it was covered with great tussocks, so that the only way it could be mown was by hand. It had to be raked by hand; and it was so soft that a horse could not walk on it, when I attempted to plough it. I ploughed that piece of land with a swivel-plough, with one of the shares on for meadow-work. I cut off the tussocks in the first place. I have an invention that cuts tussocks better than a hoe: I simply take an old broad axe, put in a long handle, and strike about level with it. You would be surprised to see how quick a bunch of tussocks will come off. Then I filled up some old ditches, and ploughed it. I put on the ordinary quantity of manure, as I have told you I do. Last year I sowed the grass-seed just before winter. The first crop was heavy enough to lodge all over the piece; and the second crop was the heaviest rowen that I grew this year, and perhaps the heaviest rowen that grew in Concord. The rowen was cut about the first of September, had one good day to dry, and was cocked up. Then we had a rain that night, and a drizzle for a week; and it blackened it very badly. I do not like that sort of hay to feed to my stock; and, as we were short of room, I said to my son, "Go out to some of those milkmen, they want to buy rowen, and see if you cannot sell this hay." He got two or three up there, and they tried the rowen to their satisfaction; and we sold it to them for eighteen dollars a ton out on that field. On less than two and a half acres we got 5,840 pounds (I know that, because I got the pay for it by weight): that was good deal heavier than most of the rowen that I had.

QUESTION. The point that I was after was this, — Some muddy lands may have hard-pan underneath; some may have sand: would you treat all those varieties in the same way?

Capt. MOORE. The piece of land I have described to you ran into every thing you have named. Some was all mud, in some you would strike down to white sand, and in some you would come down to where it was blue gravel. I do not care about ploughing very deep. I have an idea that it is no particular object to plough most grassland more than five or six inches deep.

QUESTION. Did you mix any sand with it where it was all mud?

Capt. MOORE. If it was a new piece of land that never had been cultivated, if I came down to mud, or came down to peat particularly, I should not expect to grow grass there, unless I put on loam, sand, or any material that I could get handiest; because Timothy will not grow and stand up on a piece of peat-land, without something to make silicate to strengthen the stalk.

Mr. J. P. KING (of Peabody). I belong in the eastern part of Essex County, and we do not believe in top-dressing land to any great extent. I, for one, believe that if manure is put in piles in the fall of the year on our grassland, and allowed to remain through the winter, nearly one-third of its value evaporates in the air. I am fully aware that many do not believe this; and, if I have a right to my opinion, it is because of experiments I have tried. I do not believe in top-dressing as a general rule. If my grassland needed top-dressing, I should turn it over, and take my pulverizing-harrow, and get the manure into it as best I could by thoroughly pulverizing it, perhaps in the month of September, and then I would sow on my grass-seed; and I should expect a first and second crop the next year.

We have a new way down in Essex County of getting our land into grass. We like to sow winter rye. I would not ordinarily, for a crop of rye, sow more than one bushel and a peck to the acre, but we do sow and get a good catch by using two bushels to the acre; and the consequence is, we get a crop of rye, ordinarily, of two tons to the acre, and it makes nearly as good hay, cut early and before it has seeded, as herd's-grass or red-top. Now, if that can be done as I

have done it this last year, would it not be profitable to do so? I got this year, after I cut my rye-crop, a ton of rowen to the acre; and I never knew an instance in my life when I failed to get a good catch of grass after rye. We used to sow oats, thinking that we would get a good crop of hay the next year; but many of you know, that, if we sow oats on good land, they will lodge, and kill out half the grass, and the consequence is, that the next year weeds come up, and take the place of the grass. It is not so with the rye-crop. I believe in it.

Mr. Russell. This question, germane to the subject, was handed in a few moments ago: "The land being a muck-meadow, inclining up, and stocked to grass, what is the best fertilizer when barn-manure cannot be obtained for less than eight dollars a cord? and how should it be applied?"

Dr. Nichols. I hope, gentlemen, I am not making myself too prominent. I dislike to take up too much of your time. This matter is an interesting one. I do not suppose that you expect me to go into a full discussion of fertilizers; I do not think that I can: but I will confine my remarks to some experiments, and the results of some observations, on muck. It seems to me that comes very prominently in here; and I happen to be able to give you some of the results of investigations recently made, which I think will interest you. This paper which I have here presents some views of the nature of swamp-muck, and also in regard to its value in agriculture. I notice that in this question which has been brought in here, there is no recognition of the view which is taken by some, that muck is a manure. The gentleman who puts the question evidently does not believe that muck is manure; and the object of this paper is to show you that it cannot be manure in any sense in which that term is used.

THE NATURE OF SWAMP-MUCK, AND ITS VALUE IN AGRICULTURE.

The general term "muck" has been given to those deposits of dark vegetable matter stored in low bogs and meadows, and in the bottoms of ponds found upon many farms in the Northern States. The term is perhaps as good as any that may be suggested; although it does not convey a clear idea of any special kinds or varieties, of which there are many.

The name "peat" better distinguishes the deposits in most bogs and meadows, but is not applicable to those of frog-ponds and larger basins of water. If the meaning of the word "muck" could be restricted to that class of wet-meadow products in which the natural alteration of plant-tissues had proceeded far enough to fit them for agricultural uses, it would be a convenience, and remove some confusion which now exists among chemists and farmers. It is not difficult to describe the deposits or their physical peculiarities so as to make a clear distinction between what might be called "peat" and muck; and in this discussion I will endeavor to point out the distinction.

ORIGIN OF MUCK DEPOSITS.

The origin of the deposits under consideration is not by any means obscure, and may be stated in a few words. Wherever stagnant water has existed in low basins for a large number of years, a certain class of marsh plants, mosses, and grasses have found favoring conditions for rapid and luxuriant growth. These plants have matured and decayed, finding a tomb in the impure waters which fostered their growth. As the decades of years and of centuries succeeded, with the alternations of heat and cold, the basins were filled up; so that surface-water disappeared, and matted turf, compacted with low and worthless forms of grasses, came into view. In most cases deciduous trees and water-shrubs grew in association with the grasses and mosses; and the annual fall of leaves and dead twigs contributed not a little to filling up the stagnant ponds and puddles.

Whenever vegetable growths become dead, and fall into moist earth with access of air, a process of *eremacausis*, or slow combustion, commences, which, proceeding slowly, ultimately ends in entire disorganization of tissue; and the product is called "humus." The process is different when it falls into the water; as, in the case of large trees and limbs, a dozen centuries will hardly serve to disassociate and change their cellular structure, and some of the finest and most durable timber used in ship and house construction has been exhumed from the vast swamps and bogs found in our own and other countries. The peats and mucks of our own low meadows have, to a large extent, resulted from the decay

of the smaller forms of vegetation, as grasses, leaves, and moss. Of all the various forms which have contributed to our muck-beds, the spongy mosses constitute, undoubtedly, the most important constituent.

THEIR AGE.

How long a time it requires to form a well-advanced muck-bed is not certainly known; but under ordinary conditions a hundred centuries may be required, or even five times that number. The stage of decay in which it is found does not always indicate the lapse of time consumed in the changes; as, under favoring conditions of extreme heat, or access of air during frequent low stages of water, the changes proceed much more rapidly. It is probable that no muck deposits on our farms, suited to agricultural uses, can have existed, in their lower strata, less than the time which, according to the Mosaic record, man has existed upon the earth.

DIFFERENCES IN MUCK.

When these deposits are carefully examined by the eye, they present very marked and important physical differences. In texture and color no two can hardly be said to be exactly alike. Some kinds consist almost entirely of the withered remains of plants which have undergone but little alteration, except mechanically; in other varieties the organized structure of the plant remains more or less distinctly visible; in other kinds there is no obvious indication of plant-structure existing. In the latter variety nothing remains but a black unctuous mud, which, when dried, crumbles to a fine dust. I have sometimes found this form of dried muck to be denser than water, having a specific gravity as high as 1.23; but generally it is lower than water, not rising higher than .88.

POND MUD, ETC.

It is not necessary, perhaps, to make further lines of distinction in low-meadow deposits. As regards pond sediments, they belong to a distinct class of waste vegetable material, although identical often, so far as the organic constituents go, with bog deposits.

Three forms of meadow deposits have been pointed out. Those of the first class may be called the "immature forms,"

where the constituents are coarse and spongy, with fragments of twigs, rushes, and leaves, seen in distinct outline. In the second class the organized structure of plants can be recognized, but the decay has proceeded so far as to break them up into almost indistinguishable forms. These products are rather light and spongy, but much denser than those of the first class. The third class is the black, dense, perfectly metamorphosed humus, with a clayey feel, and, when touched, leaves discoloration upon the finger.

The two first varieties I will designate as "peat;" the last, "muck." All these forms when dried are useful for fuel, but not for employment upon the farm, unless, possibly, as absorbents for liquid manures. The first two forms had better be cast out of the category of useful farm agents, and attention only be given to muck proper.

MUCK PROPER.

Muck, then, considered as the most advanced of all bog deposits, is easily recognized by its peculiar physical conditions, and is the only substance about which farmers need concern themselves; and it now remains to consider its value as a manurial agent. The large amount of water mixed with muck in its natural state is a most serious obstacle to its farm employment. It may be stated to hold a minimum of sixty per cent, and a maximum of ninety-two per cent, the average being, in New-England mucks, not far from eighty-five per cent, of water. To cut out a water-soaked substance like this from a treacherous, spongy bog, lift it into carts, and haul it long distances, involves great labor and expense. If it is allowed to air-dry on the spot where exhumed, some advantage is gained; but it must be remembered, that, under the most favorable weather and conditions for drying, much water remains to be transported. Experiments at my farm upon air-dried mucks, extended over five seasons, showed that water remained in the material to an extent varying from thirty to forty-seven per cent. It is probable that not many farmers have ever seen a specimen of absolutely dry muck; that is, such specimens as the chemist has in hand in making his analysis in the laboratory. The absolute water-free muck is a light substance usually, which the wind will scatter as it does a handful of feathers.

When muck is spread upon a field, much of it blows away in the high winds of summer, when it is very dry from exposure to the hot sun. This is a source of loss not usually taken into account. The light mucks oftener belong to the first and second classes, or what I have designated as "peats."

CHEMISTRY OF MUCK-BEDS.

The chemistry of a muck-bed is interesting, and deserves brief remark, although the analysis which I have to present will afford information upon this point. It is plain that a substance so under the constant influence and action of water can contain no ingredients soluble in that fluid; and hence we fail to find in the ash of muck any of the soluble forms of plant-food. None of the valuable soluble salts of potash, soda, or phosphoric acid, are present in the muck-bed, unless in extremely minute quantities. In soils on higher lands, the humus and ash contain all these soluble agents, derived from the decay of vegetation. It must be kept in mind, that vegetation decays in water under different conditions from that when exposed to air, or in the presence of oxygen, and a different condition of the resultant mass must be expected.

The greater portion of the inorganic material of muck is lime in its insoluble form, silica, iron, alumina, and often magnesia. Of the alkaline earths, lime is present in greatest abundance. From a careful consideration of the results of analysis of a large number of specimens of muck made during the past quarter of a century, under my observation, I have no hesitation in saying *that the ashes of muck are practically worthless to the farmer as a source of plant-food.* I say *practically* worthless; meaning by this, that the inorganic constituents of mucks contain so little of valuable, available, plant-nutriment, that, if they held no other forms, they would be entirely unworthy of attention, even under the most favorable conditions. This view is sustained by the investigations of Kane, Sullivan, Vaux, Regnault, Mulder, Baer, Peterson, Anderson, Wagner, and many other eminent chemists in Europe, and Johnson, Storer, and other chemists in this country: in short, it is sustained by the analysis of every competent chemist whose researches have extended in that direction.

NITROGEN IN MUCK.

As regards the other forms of valuable plant-food contained in muck, I have only to consider nitrogen. All analyses prove the presence of potential nitrogen in mucks, and in some it is found in considerable quantities. The form in which it exists is in combination with organic acids, — the humic, ulmic, crenic, and apocrenic. It has been alleged that free ammonia has been found in some bogs; but I have failed to detect it in any specimens coming under notice, and no reliable chemist so far as I can learn, has declared its presence. Nitrogen is the most costly, and, indeed, the most valuable, of all forms of nutriment needed by plants; and the question of its value as found in mucks is one of high importance in this discussion.

ANALYSIS OF MUCKS.

In the table of analysis presented below, a clear view is given of the amount found in three typical specimens of muck; one of which is from a bog on my farm at Winnekeni, one from a remarkable deposit in Boxford, Mass., the other from a well-known bog at Plaistow, N.H. The equivalent in ammonia (NH_3) is also presented.

	Nitrogen.	Ammonia.
	Per Cent.	Per Cent.
Winnekeni Farm	.56	.68
Plaistow, N.H.	.31	.37
Boxford, Mass.	.50	.61

The above is as found in the wet condition. In the water-free state it stands as follows: —

	Nitrogen.	Ammonia.
	Per Cent.	Per Cent.
Winnekeni Farm	2.47	3.00
Plaistow, N.H.	2.13	2.55
Boxford, Mass.	2.12	2.59

	Per Cent.
The average of fifteen determinations of nitrogen in wet mucks, by Professor Johnson, is	.42
Water-free	2.31

It will be noticed that Professor Johnson's determination shows a little higher percentage of nitrogen in the dry muck than those which I have presented; but the difference is trifling. Taking muck-beds as they are found in the Northern States, it will be safe to assume that they hold on an average, in the absolute dry condition, about two pounds and a quarter of potential nitrogen in each hundred pounds.

The following table gives the results of the analysis of five specimens of muck, showing the amount of water, organic matter, and ash, contained in each: —

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
Water	77.36	85.49	76.46	89.35	36.74
Organic (vegetable and volatile matter),	19.65	14.39	22.97	9.64	5.30
Ash, including sand	2.99	.12	.57	1.01	57.96
	100.00	100.00	100.00	100.00	100.00

In No. 5 will be noticed a very great dissimilarity of composition from the others. This specimen was taken from the bare bed of Plug Pond, in Haverhill, Mass., and in appearance is densely black, fine, and "well calculated to deceive." From this bed a neighbor had taken many hundred cartloads at great expense for use upon his farm. It is a specimen typical of usual pond deposits, which are largely employed in agriculture all over the Northern States. They are worthless specimens.

No. 1 is the sample from my farm, from which the nitrogen determination was made, as given above. The amount of lime contained in the ash (not given in table) is 1.7 in the dry state. It is fully decomposed, dark, and every way of excellent quality.

No. 2 is the sample from Plaistow, N.H., and contains a less amount of water, a larger percentage of ash and organic matter, than No. 1, but is of very good quality.

No. 3 is from Boxford, contains about the same amount of water as No. 2, much less ash, and more organic matter. The nitrogen contained in the last specimens has been given above.

No. 4 is from a large basin called "Sour Meadow," on the margin of Lake Kenosa, in Haverhill, Mass. This specimen holds nearly ninety per cent of water, and has but one per

cent of ash. It is not well decomposed, having fragments of leaves, grasses, etc., in the mass. The five samples have been selected with the view of presenting the extremes of variation in muck-beds which are drawn upon by New-England farmers for agricultural purposes. It is now possible to present a clear estimate of the value of the nitrogen in the best specimens. No. 1 from my farm-meadow contains in each ton (two thousand pounds) of water-free muck forty-nine pounds and four-tenths: this at fifteen cents (a fair price) gives a money-value of seven dollars and forty-one cents for the nitrogen. The value of all the mineral and nitrogenous plant-food it contains may be stated as follows: —

Nitrogen	$7.41
Lime	.30
Other salts	.10
	$7.81

The cost of procuring one ton of absolutely dry muck may be understood from the fact that ten tons of the wet mass is required, estimating the water at ninety per cent; which is a fair average for successive seasons. A ton of wet meadow-muck of best quality is thus shown to have a value of seventy-eight cents as fertilizing material for farm-crops, estimating its mineral plant-food constituents as we estimate that found in cow-dung.

ANALYSIS OF COW-MANURE.

With the view of affording a comparison of muck with fresh dung, a sample taken from my barn-stalls (the droppings from cows in milk) is here presented. It contained of

	Per Cent.
Water	81.08
Organic matter	15.96
Ash	2.96
	100.00

The result of this examination may appear somewhat startling, inasmuch as it shows that the fresh cow-dung from the barn contains more water, and less organic matter and ash, than is found in the muck on the farm forty rods distant. It would appear (other things being equal) that the muck is

as valuable, or even more valuable, than the dung; but important considerations come in to dispel this illusion. A complete analysis gave, as contained in each ton of the fresh dung, the following amounts of valuable constituents: —

	POUNDS.
Nitrogen	5.11
Phosphoric acid	3.55
Potash	2.00

The nitrogen in manure has a higher value than that in muck; but estimating it the same, with the phosphoric acid, potash, etc., the value stands as follows: —

$5\frac{1}{10}$ pounds of nitrogen, at 15 cents	$0.76
$3\frac{1}{2}$ pounds of phosphoric acid, at 12 cents	.42
2 pounds of potash, at 7 cents	.14
Lime and other salts	.33
	$1.65

ANALYSIS OF LIQUID EXCREMENT.

The nitrogenous and mineral value of muck stands to fresh cow-dung as seventy-eight cents to a dollar and sixty-five cents per ton, water-soaked, or nearly three to one in favor of the latter; but it must be remembered that fresh cattle-droppings do not represent manure as found in farmers' barn-cellars. This consists of a mixture of the liquid excrement with the solid. A ton of fresh urine, as determined in analysis from specimens collected at my barn, gave the following results: —

	POUNDS.
Nitrogen	17.50
Phosphoric acid	10.12
Potash	15.90

This result indicates the very high value of liquid manures, giving a value per ton of about five dollars, the estimate being made in accordance with that for muck and for solid excrement. A ton of well-mixed manure, containing equal proportions of the solids and liquids, has a money-value of not far from four dollars; or this is the value of the manure stored in the barn-cellar at Winnekeni Farm, as learned from analysis.

MUCK-HUMUS.

Let us look for a moment at the nature and value of the naked muck-humus, — that is, what remains after the separation of the nitrogen and salts, — and contrast it with exhausted manure. The humus, or "geine," as Dana persists in calling it, which results from the decay, or mouldering, of vegetable matter under water or in moist places, is a very different substance from that which results from the decay or decomposition of hay and grains in passing through the digestive and assimilating organs of animals. It must be admitted that muck very rarely represents merely the mineral constituents of the plants from whose remains it has been formed; neither does its organic portion represent those structures, as when changed under other or usual conditions. In virtue of a kind of dialysis, or chemical re-action, not only mineral constituents are changed or abstracted, but vegetable tissues undergo a metamorphosis which renders the changed mass not as well suited as other varieties of carbonaceous material to form fertile soils.

Hay and other forms of food consumed by animals, in passing through living organs, have their elements so acted upon, that they speedily pass into putrefactive fermentation, which breaks down tissues or cellular structures with great rapidity. The catalysis of life impresses a peculiar power upon animal foods, and introduces a force of disassociation not noticed in other processes: hence *manure* has properties not found in any substance adapted to the nourishment of plants. Muck-humus and dung-humus can only be contrasted to the advantage of the latter. The former resists change (necessary change) when applied to silicious soils; and when muck-humus is mixed in association with manure, the former is distinguishable on fields often for several years after the latter has gone from sight. In any just and accurate estimation of the comparative value of muck and manure, this important factor must not be lost sight of.

FARM-TRIALS OF MUCK.

To present in detail the observations and experiments upon muck made at Winnekeni Farm in the past quarter of a century would require space only afforded by a large vol-

ume. In this paper a brief outline or summary is presented. In trials of muck upon the farm, a systematic plan has been adopted, with the view of securing reliable results; and these show that muck is not manure in any proper sense in which that term is used. They further show, that the substance cannot be made into manure without an expenditure for added materials, and at a cost of time and labor which do not comport, under usual conditions, with proper farm economy. The simple mixing of lime with muck betters its condition, but it does not change it into manure.

If muck in its partially-dried condition is to be changed into a mass corresponding in some particulars with manure, not only lime, but nitrogenous salts, potash, soda, soluble phosphoric acid, and other less valuable forms of plant-food, must be added. I have succeeded in forming artificial manures at the farm, using muck as a bulk basis and absorbent, which afforded very gratifying results when applied to growing crops; but the cost rose, in all cases, in due proportion to its value.

In these experiments the material in hand to begin with (muck) had a certain known value, and it would be manifestly empirical to expect from the use of that material benefits which it had not the power to bestow. In trials upon fields, in most instances, I have not learned that the raw material, air-dried or wet, gave results in increased fertility corresponding with expenditures incurred in its application. On dry silicious soils it has not supplied the place or served the purpose of natural upland humus. On medium low lands it has rarely indicated, through successive seasons, any influence for good.

MUCK-MEADOW EXPERIMENTS.

A portion of the farm-meadow from which muck has been taken was reclaimed and drained a dozen years ago, and nearly a thousand loads of sand carted upon it. This afforded, for several years, heavy crops of upland grasses; but, like all muck-meadows, it requires applications of fertilizers to maintain fertility. The surface-soil of a muck-meadow is, from obvious reasons, better adapted for plant-sustentation than the contents deeper down. Portions of the bog were turned up to light and air from depths of a foot or more; and

on this, without sand or fertilizers, potatoes were planted. The crop was a failure, although the season was favorable. Root-crops, the cereals, and even the better grasses, do not flourish on a deeply ploughed muck-meadow, so far as my observation extends; and there is indeed no reason to expect different results. These crops all require potash and phosphoric acid for complete development, — agents which are not present, except in minute quantities, in any muck-field. Experiments with muck-soils upon all kinds of plants in pots, carried through several seasons, have supplied interesting facts; but the statements regarding them must be left for another paper and another occasion.

VIEWS UPON THE VALUE OF MUCK.

The laboratory researches upon muck undertaken at my farm, of which a brief and imperfect account is here presented, correspond essentially in result with those of Professor Johnson, and all other chemists at home and abroad who have entered upon like labors. Such, however, is not uniformly the case with the practical use of the material by farmers in the field. A large number of quite intelligent men declare its influence in the direction of soil improvement to be marked and decisive. Others are so loose and extravagant in their statements of benefit received, as to render them of very doubtful accuracy. Nothing is more deceptive and uncertain than observations upon farm-crops, and the influence of soils and fertilizers, when no careful methods and no weights and measures are employed. The eye, used only in a casual way in the hurry of farm-work, is not a safe guide. Much of the confusion and uncertainty in which practical husbandry is involved are due to hasty, careless, unmethodical observations in the field. Better methods and more care are desirable.

CONCLUSION.

To sum up the whole question of the agricultural value of muck, it may be said that it is of great value as an absorbent of liquid manures; and, where it can be obtained easily, large stores of air-dried muck should be secured and used by every farmer. As an application alone to soils of any variety, — silicious, dry, humid, or any other, — it has a very small

value. Its whole contained amount of mineral plant-food does not equal in value more than fifty or sixty cents a ton, and the bog-humus in which it is involved is of little value except as an absorbent.

Now let me answer the question. I think that ashes upon meadows have always answered a very excellent purpose. I should recommend the use of ashes always, if you can procure them. If you cannot obtain ashes, the use of sand is excellent. As Mr. Moore has told us, it gives strength to the grass. It probably becomes, in part, soluble, — soluble silica, — and supplies food to the plant. I have found it on my meadows to operate very well.

Mr. George J. Peterson. I have often thought that we needed an agricultural dictionary. It seems to me, from this discourse, which is one of the most valuable that has been presented to the Board for twenty years, that the doctor is the man to make that dictionary. For instance, we would all like to know what nitrogen is. You, gentlemen, all understand that nitrogen is a subtile element, but an exceedingly valuable one.

Dr. Nichols. I suppose there is a great deal of confusion existing in relation to the employment of the word "nitrogen" in agriculture. Let me see if I cannot show you what is meant by it. Of course, nitrogen is all about us, and forms a very important constituent of air. I have had farmers of considerable intelligence come into my laboratory, and wish to know if I could not furnish them with a bag of nitrogen. Of course they made a mistake. Nitrogen itself is a gaseous body. I suppose the plant must get a portion of nitrogen from the air. I am inclined to think, that, with the common atmosphere, nitrogen is assimilable to a certain extent; how far, I do not know. But when we speak of "nitrogen," we speak of it in combination with other substances, locked up as it is with various salts, — for instance, in sodium it is locked up with caustic soda, — and it has a certain value in those combinations. The plant, when this is dissolved, seems to have the power of appropriating those molecules of nitrogen, and making them into plants; and it serves a very good purpose. I have not cleared up all the points about nitrogen. I can only give the commercial value of nitrogen as we find

it in the market. Never, in any case, can you force nitrogen into combination with plants, unless it is first in combination with some other substance, or in the form of ammonia.

QUESTION. I would like to ask how leached ashes compare in value with unleached.

Dr. NICHOLS. That question has been so often asked, that it would seem that most of us ought to know something about it. It depends altogether upon the degree of exhaustion of the potash. The soap-boiler will give you leached ashes which are worth very much more than some others. There is always a portion of alkali in the ashes. I should think that, ordinarily, leached ashes were worth ten cents per bushel, when dry Canadian ashes, giving five pounds of alkali to the bushel, were worth thirty-four cents. That is an approximate estimate.

Mr. PAUL (of Dighton). In regard to the matter of leached and unleached ashes, all I know is as to the results. I have used for twelve years from five hundred to nine hundred bushels a year; and during those years I used, probably, from a hundred to three hundred bushels of unleached, the remainder being leached. A portion of the leached ashes was from soap-boilers, and a portion of them was imported from Canada, said to be hard-wood ashes. I must confess that I made no test or measurements of my crops, which is a very important thing to do; but I observed on my own land and my own crops. I cannot give just the pounds or just the bushels; but, using them side by side, I came to the conclusion, after the experience of years, that, practically, there was but very little difference, on my soil, between the effect of the leached and the unleached ashes. If Mr. Slade is in the room, I think he will corroborate what I am saying as to the effect of the use of ashes in my section of the country. I heard Dr. Nichols in Fall River answer this same question. I think, although I am not quite sure about it, that he then gave leached ashes rather more value than he does now. I have found very little difference practically; and I have watched very carefully, because I get my living from my farming, and I do not want to use any materials unless I get my money back. I have come to the conclusion that the unleached ashes give about the same result as the leached; at least, the effect is so nearly the same, that I cannot tell the

difference on my crops. I live near tide-water, but the water is not salt there. During the dry season of the year, the water is brackish; and my land consists of a variety of soils, — some of it is sandy, and some of it has a compact subsoil, and some is porous.

QUESTION. Do you use other fertilizers with the ashes?

Mr. PAUL. Yes, sir. I have used a large variety of fertilizers. I use, during the same year, upon some crops, possibly stable-manure and ashes, guano, bone, phosphates, potash, refuse from the porgy oil-works, and various other materials. I do not use the ashes in combination with other manures, only during the same year. I use manure more freely than many of our farmers do. I put on in the spring a good application of stable-manure, or manure made at my barn, and it is worked into the ground; then an application of ashes; possibly, during the season, an application of fish-guano from the porgy-works, and possibly an application of Peruvian guano, or of the superphosphates, as found in the market.

The CHAIRMAN. Have you ever experimented with leached and unleached ashes without the use of any thing else, so that you know the result was not attributable to some other fertilizer?

Mr. PAUL. No, sir; but I have used equal quantities of the two materials on my crops without being able to detect any difference in the results. I seldom have a year when I do not use more than one fertilizer on my land.

The CHAIRMAN. There is a point where I think the gentleman, like a great many others, is at fault. We use something else, and we do not know what to attribute the product to. If he did not use any other fertilizer on a given spot but leached ashes, and on another spot used nothing but unleached ashes, then he could tell us something definite as to the result; but he does not know whether some of these results are not attributable to some other manurial agent that he has put in.

Mr. PAUL. I have only inferred, that, if the potash which is leached out in the process of leaching was of value, it should tell on the crop, when there is so much potash put on in the one case, and not so much in the other.

The CHAIRMAN. My explanation would be this, — that he is using the ashes on a soil that does not require potash, and

consequently there is enough given in the leached ashes. He has virtually wasted the extra amount in the unleached ashes.

Capt. MOORE. I think, if you will call upon Professor Goessmann, he will give you a solution of this problem; and it will probably be this, — that some soils in Massachusetts need potash, and some do not.

Professor GOESSMANN. The question has been already answered in part; but I think we might take a broader ground. The principle on which vegetable growth is founded is the principle of restitution. If the soil has not potash, the plant which needs it will not grow. If a potash fertilizer added to the soil does not make an impression upon the crop, it shows that potash is not wanted. One thing is sure, — and that is the only thing that is sure, in connection with this question, — the essential constituents of plants cannot replace each other. There are six or seven substances which are essential to plant-growth: if one is wanting, the rest cannot operate. This applies to lime as much as to potash; to phosphoric acid as much as to nitrogen. In our plant here, we find the potash is the larger proportion of the saline constituent. Wherever that plant grows, it must find some potash. In this case, undoubtedly, the soil already contained a sufficient amount of potash to supply the quantity required to produce the growth: without it, it would not have grown. The question is, Where did it come from? Of course, the name "leached ashes" is a collective name, and applies to a variety of materials: sometimes merely the potash has been abstracted; sometimes the ashes have received a certain amount of lime. The potash which the ashes contain may supply the amount required for the growth of the plant. But there comes in another point. If the leached ashes have received an addition of lime — lime is a material which may set free potash; and upon clayey soil the application of lime not only supplies the lime for the plant, but it is a powerful disintegrator of the constituents of the clay. The clay originally came from a rich potash compound, granite. When that clay is only in part decomposed, then, of course, the lime may elaborate a large quantity of potash from the soil; and this is an advantage of the latent resources of plant-food in the soil. If, therefore, these leached ashes operate as has been stated, there are two causes possible, — either that

the soil was rich in potash already, or the addition of the lime in the leached ashes has elaborated a sufficient amount of potash from the other natural substances to feed the plant. But without potash the plant could not grow: a certain quantity was required; and, if it was not in the soil, it must have come from some other source. The soil may be the source.

Mr. WHITAKER. Are there not in New England, and particularly in Massachusetts, a large number of sandpits which contain a large quantity of potash?

Professor GOESSMANN. Yes. "Sand" is also a name which is applied to a great many things. If sand means merely pulverized quartz, it is one thing: it cannot supply plant-food. It may improve the physical condition of the soil, make the soil pervious, but it cannot feed the plant. If your sand is ground granite, — like the sand along the seashore in Kingston and Marshfield, for instance, — such sand is a most valuable constituent of the soil. That soil is far better than the average soil in the State. It consists in the main of crushed granite rock. It is felspar, a constituent in the granite, which gives us the potash. Whenever this mineral constituent is in the sand, of course that sand has a powerful effect on plant-growth. But sand and *sand* are two things, — in the one case, ground quartz; in the other case, largely ground felspar. The two differ widely from each other in composition. If sand contains felspar, then it contains potash, — one of the most valuable constituents of the soil.

Recess until two o'clock.

AFTERNOON SESSION.

The meeting was called to order at two o'clock.

The CHAIRMAN. We have with us this afternoon a gentleman from Norfolk County, — an intelligent farmer, — who has a very different farm from the one of which we had the history this forenoon. He went on to that farm, and levelled up the hollows, cut down the knolls, and made the desert to bud and blossom as the rose; and, besides all that, he edits a paper. I take pleasure in introducing Mr. A. W. CHEEVER, of "The New-England Farmer."

GROWING AND FEEDING FORAGE CROPS IN NEW ENGLAND.

BY A. W. CHEEVER.

Mr. President, Ladies and Gentlemen, — I may say, in opening the subject assigned for discussion this afternoon, that, having spent fifty years on one of the most forbidding farms originally that can be found in Massachusetts, I have learned to have faith in New-England agriculture.

I believe that here in Massachusetts a young man who has a taste for the business, one who loves the soil as a good sailor loves the sea, can, by intelligent industry joined with a reasonable degree of prudence and thrift, attain a success such as the majority of men engaged in other occupations would consider enviable.

Not that all mechanics or tradesmen would desire to exchange places with the farmer, and accept all his burdens, and butt against all the obstacles he may have to contend with during his career (for many may feel that they would be incompetent to meet and overcome them); but they would be glad, if it were possible, to exchange final results, — to accept the farmer's well-tilled acres; his fat oxen; his thrifty, well-trained steers; his deep-milking cows; his promising heifers; his well-bred sheep, swine, and poultry; his loaded fruit-trees; his neatly-kept garden, with its wholesome vegetables, luscious fruits, and beautiful flowers, — in short, his New-England country home as a whole. Indeed, such a home as many farmers have, and more might have, is the life dream and hope of many a merchant and mechanic who will end his days amid the rattle of paved streets and the din of a busy city with hopes and dreams unrealized.

I admit that legitimate farming in New England can give little promise of a very large money-return above a generous living, and a good education for the rising generation; but I count this lightly against the business, for I am told that history tells of tribes of people who knew nothing of what we call money, and yet whose enjoyment of life without it might be the envy of the millionnaire.

With the American people, who have had a new country to subdue and develop, activity and enterprise are characteristics that have been bred in the bone. The healthy Yankee boy finds that energy, and ambition to do, is a part of his nature, and a controlling power.

The New-England farmer of the past, with his house to build, his unsubdued hills to make smooth, his valleys to drain, and his children to clothe and educate, has been compelled, not only to work, but to economize, till in many cases he has acquired, and justly too, the reputation of being, not only an "independent," but a "tight old farmer."

He has felt himself compelled, in his battle of life, with rough-cast acres to develop on one side and the wily tradesman to contend with on the other, to hold on tightly to the strings of his not over-plethoric purse.

Farming in New England, even within my own memory, would have been more appropriately designated, had it been called, as it is now called at the South, "cropping;" for really, there was very little perfectly honest dealing with the soil that was cultivated. Seeds were sown, and crops harvested and consumed, or sold; but who ever thought of paying any debts due to the land?

The agriculture of our fathers may have been justifiable robbery, but it was robbery nevertheless.

And had not the school-boys whom those early crops helped to feed and educate learned of principles concerning the cultivation of the earth of which their fathers never knew and scarcely dreamed of, New England, ere this, might really have been left "out in the cold." But the turning-point is passed. The future is brightening for New-England agriculture. Men of other callings, realizing its importance in many cases even more than do farmers themselves, because possessed of the facilities for a wider observation, have given it of late much of their attention, and are endeavoring to make the cultivation of these worn-out Eastern farms a financial success; while many others are turning towards it, impelled by an inborn love for old mother-earth.

I have told you that I believe in New-England agriculture. I do not forget that men have gone to the great Western prairies with their large capital, which they have invested in acres by the thousand and hundred thousand, in implements for tillage and harvesting which would drain almost to emptiness some of our large agricultural-implement warehouses, in cattle-grazing upon government land, in herds extensive enough to consume the feed in either of our large Massachusetts counties in a single week; and that the possi-

bilities of profit from such enormous investments are almost beyond the comprehension of ordinary minds. I do not forget, either, that men have gone West, and have grown up with the growing country, and become wealthy without great effort. Nor do I forget the cries of suffering, and the hardships inseparable from pioneer life, and the falling by the wayside of the thousands upon thousands whose lives have been sacrificed in this "will-o'-the-wisp" pursuit after a soil more easy to cultivate, and which will constantly give without receiving.

So, when I say that I believe in New-England agriculture, I mean that — taking into consideration the natural character of the soil, the high degree of intelligence that may now be brought to bear upon it, the excellent markets which have grown up at our very doors, the permanent improvements which our fathers and grandfathers have left in every town and county (grand monuments to their industry, economy, enterprise, and patriotism), the beautiful scenery among our wooded hills and river-valleys, the old associations which bind families and neighborhoods, and, last but not least, the burying-grounds where repose the ashes of conscientious fathers, kind and enduring mothers, and loving friends and relatives — New England still holds out inducements to young men who can appreciate these things, fully equal to any thing which the emigrant to a new country has a right to expect during the generation in which he himself lives. I do not propose to quarrel with history; for I am aware that the westward march has been a march of necessity; that under the prevailing ideas, or perhaps the lack of ideas, the old hive could not have contained all the increase of a thrifty people, certainly not all the thousands upon thousands who have joined us from foreign countries: but I can plainly see in this emigration movement the same ideas prevailing which have been a curse to American agriculture almost from the day the Pilgrim Fathers first set foot on these shores.

I refer, of course, to that system of agriculture which makes land grow poorer under tillage, rather than better, and which, sooner or later, must compel cultivators to seek new fields. The agriculture of New England during the past two hundred years, like the agriculture of the United States to-day, hardly deserves the name of agriculture.

I am reminded of the story of a little boy who asked his father if he might go off with a party of other boys for huckleberries. The father gave his consent, and also some good advice. Said he, "Now, Johnny, when you get to the huckleberry-pasture, you will hear some of the boys say, 'Oh, how thick they grow here! come and pick with me.' And another will call out, 'Come and see what a lot of them I have found!' And you will see some of the children spending half their time running from bush to bush over the pasture, trying to find the thickest picking. Now, when you find a bush, or clump of bushes, on which the berries are fairly thick, begin to pick, and fill your basket as though you intended business, and stick to that place till you have picked all the ripe berries that are worth picking, and don't spend your time looking for thicker berries, so long as you find fairly-good picking where you are." The boy heeded the advice of his father; and it is needless to say, that, when the children returned, Johnny had more berries to carry than any of his comrades who had been continually finding better picking, but who lacked the patience to stick to their business. Could the boys of New England for the past two or three generations have been taught to believe in New-England soil as some of us believe in it to-day, and could they have been induced to apply the same energy, skill, and capital that they have used in developing the West, what a picture would New England now present! We are talking of establishing, at great cost, a large park somewhere in the suburbs of Boston (doubtless a very desirable thing to do); but if the farms of Massachusetts for a hundred years past could have been cultivated as some farms are cultivated to-day, and with profit too, Boston might now have had a park that would have been limited only by State lines.

Massachusetts is a thrifty State. For density of population she stands first in rank among all her sister-States, and sixth among all the countries of the world; and yet, if the State were to be divided equally among all her inhabitants, there would be over three acres for each man, woman, and child, or a twelve-acre farm for each family of four persons.

Should not such an area do more towards producing the food consumed in the State? The truth is, we buy nearly all our flour, most of our meat, much of our butter and

cheese, and all of our sugar; while the milk sold in our cities is much of it produced from purchased foods.

We have been so often told that New-England soil is unworthy of cultivation, that many of us have come to believe it. The interested speculator in Western land will tell you that a man who knows what he is about cannot afford to take a New-England farm of ordinary quality as a gift.

From my own experience and extended observation among intelligent farmers from Rhode Island to Canada, I think I may say that a man who *does* know what he is about may with safety purchase almost any New-England farm; and if he pays only what the same value in buildings, necessary fences, and pure water, would cost him at the West, the land itself will cost him little, if any, more than nothing.

What New-England soil most needs is men who have faith to cultivate it; and there is plenty of evidence that such men are becoming more numerous, and that the number will increase, as agricultural knowledge increases, until New England shall be noted, not only for being the birthplace of great and good men, but also the home of those whose love is too strong to forsake her.

As I know comparatively little of farming, except what I have learned by experience, I hope I may be pardoned, while treating the subject before us, if some of the every-day operations which I am now carrying on shall appear somewhat prominent.

You know that different individuals may have a common aim or end without necessarily approaching it by the same path. You know there are men now at work, as they believe, for the common good, who are striving by all the power and knowledge they possess to perfect the dairy cow; and you know that some very astonishing results have been reported. That over seven hundred and fifty pounds of good butter can be made in one year by a single cow, that produces a calf in the time, is a statement, which, had it been made a few years ago, would have found no believers; and even now it is quite possible that as many dairymen can be found doubting as believing it. But allowing that these reports of large yields are correct, and even more, that the possible yield from a single cow has never yet been reached,

the fact still remains that the great mass of butter-consumers must, for a long time yet to come, be supplied by cows that will very rarely astonish their owners by a close approach to the extreme high figures. Is it not to be feared that a cow which so far outstrips the average of her race will necessarily fail to stamp such remarkable superiority upon her offspring?

It is told of a certain tough old farm-laborer, who lived and worked in my town a generation or more ago, that, when undertaking an extra hard day's work loading manure, he stipulated with his employer that he should be furnished a quart of cider to drink for each wagon-load drawn out. It is not hard to believe, that, with two teams to haul them, and the distance being short, that fifty loads found their way from the stable-windows to the field; and, as the story goes, the fiftieth quart of cider disappeared as the last load went out. Some of you may think of men who would be willing now to undertake the cider-drinking part of the exercise; but I doubt if there is a man present who would have much confidence that he could successfully complete both operations.

Now, it seems to me that it is expecting too much, from cows that have beaten the world in their individual yields, to expect them to produce calves year after year capable of excelling or even equalling themselves.

However successful such efforts may prove, — and we all certainly hope for the best, — common farmers must, for the present, still go on with such stock as they have, or can readily obtain, and must accept results of far less magnitude.

It used to be the fashion, when relating accounts of large yields of milk or butter, to throw in the remark, as an additional point in favor of the cow, that she had been kept all summer in a very poor pasture. I think this fashion is going by. Men who have learned that soils must be fed, if they are constantly cropped, need not be told that animals which produce much must also be freely fed. Good keeping may not alone make a good cow of a poor one; but poor keeping will certainly render a good cow unproductive and unprofitable. Although I have aimed to establish, by breeding, a good herd of dairy cows, yet I have given, perhaps, greater attention to feeding, and especially to learning some-

thing of the possible capacity of our average New-England soils. The farm upon which these experiments have been carried on is called a hundred-acre farm, and, when I first knew it, had sixty acres in mowing, tillage, and pasture, and forty acres in wood.

It kept from three to five cows and heifers, a yoke of oxen, and a horse. About forty acres were mowed or cultivated annually, and about half the pasture was also mowed nearly every year to keep down the bushes. The pasture would never keep three cows well through the season; but by pasturing the mowing-lands as soon as the crop of grass was removed, and feeding some hay and grain, the previously named number of animals managed to live.

The annual sales consisted of two or three tons of hay, a little butter, two or three veal calves, a hog, and occasionally a few eggs and chickens.

The hay sold paid the taxes; and enough wood was cut in winter to pay a hired man for six or seven months.

The manure was all thrown out through stable-windows in winter, and left where it dropped in summer, chiefly in the bush-pastures.

My grandfather bought the farm more than eighty years ago, and commenced improving it by digging what stones could be pried out with crowbars and levers, and piling them in rows, about four feet high, across the farm.

The number of stone walls required to fence a farm at that time, it would appear, depended chiefly upon the amount of material at hand. Our fields averaged less than two acres each, while several contained less than a half-acre.

A piece of swamp-land was flowed by an expensive dam, with the view of killing bushes, and bringing in swale-grass, which was cut, and carried on shore upon hand-poles. A large amount of the soil in this swamp was dug out in dry seasons, and carted to the barn-yard for composting, leaving several unsightly frog-ponds to be counted in among the improvements. The large rocks left undisturbed, after building the two or three miles of heavy wall, were thicker in the mowing and tillage fields than were ever the hay-cocks in the best grass-year. The usual rotation was, first year, potatoes on sod, ploughed in the fall, and cross-ploughed in the spring (the numerous rocks made it necessary to cross-

plough for each and every crop); second and third years, Indian corn (the land was then considered fit to seed down; and oats and grass-seed, including clover, were sown together in spring); fourth year, clover and after-feed; fifth, sixth, and seventh years, Timothy and red-top, with the native grasses gradually taking the place of those sown; eighth, ninth, and tenth years, and often two to five more, a light crop of inferior hay, and pasture, or pasture exclusively: when the same round was begun again. Ploughing sod was a much-dreaded operation, requiring a strong team and much patience; and to plant and tend from two to three acres of corn and potatoes was considered a pretty good summer's job.

Thirty years ago a radical change was made in the management. Indian corn as a grain-crop, and which had rarely yielded forty bushels per acre, and frequently less than twenty bushels, was abandoned, and corn for green-feeding was grown instead. Oats were also cut early, and fed green, or made into hay. The number of milch cows was gradually increased to ten, and an extra yoke of oxen was added to the team.

Small fruits, for home use, and orchard-trees of many varieties, were planted for market purposes; though the dairy was made the leading business of the farm, and required the purchase of large quantities of grain. Additions were built to the barn, and better conveniences provided for the dairy. The dam across the meadow was dug through, and numerous ditches opened for carrying away surface-water. A cellar was dug under the barn, and the manure saved with care, and spread bountifully over the fields as far as it would go. As they were needed, better ploughs, and other modern farm-implements, were purchased. Mowing pastures to keep down bushes was discontinued, and some thirty acres given over to the growth of wood; while a few acres of the old mowing and tillage land that was farthest from the buildings was set apart for a permanent pasture and exercising-ground for the dairy herd. The clearing and enriching operations, commenced near the buildings, were gradually extended, until twenty-six acres were rendered fit for cultivation, — twenty-two acres in one field, and four in another, — separated by a lane leading from the barn-yard to

the pasture. No other fences are now maintained, either across or around the tillage land, although it is bounded on two sides by the public highway.

The heavy work of clearing and draining being finished, a pair of horses were able to do the work which formerly required four oxen and a horse; and, as the butter-market improved, the dairy has been increased, till the milch cows now number from fifteen to seventeen. Finding it often difficult to purchase good cows, breeding them was commenced some ten years ago; since which time the farm has carried, besides its quota of mature cows, a constant relay of young animals, from which to draw as the older ones went to the butcher. For the past few years the farm has carried from twenty-five to thirty hay and grass eating animals, less than ten per cent of them being under a year old.

During the past two years there has been a few tons of hay sold, but none bought. Previously, while the stock was being annually increased, hay was sometimes purchased.

For many years it was my aim to feed chiefly the very best early-cut hay and rowen that I could grow, both winter and summer; though green corn was grown and fed freely during some two months in summer.

As much grain was also purchased and fed, both in winter and summer, as was considered safe to feed, and maintain sound health in the herd.

This system brought excellent results in the way of rich milk; but the milk cost too much, while, in unfavorable seasons for the growth of grass upon dry hillsides, it was found necessary to purchase hay to an extent that left little margin for profit.

Latterly, an entirely different system has been introduced and adopted.

Each year, during the months of September and October, as large a field is sown with winter rye, at the rate of from one and a half to three or four bushels per acre, as may be required for feeding all the stock in the spring from the time it first begins to show a head until it is nearly ready to bloom. The cutting will begin, according to the earliness or lateness of the season, from the first to the middle of May; and, if several sowings are made, the cutting may continue about three weeks, the earliest-sown being about

ten days ahead of the latest, while each sowing should last about a week.

As soon as the heads are at their full height, and before a single blossom is seen, the whole field remaining should be mowed, and made into hay, to be fed at any time, summer or winter.

Two years ago I fed rye-hay exclusively about three weeks, or till new hay came in, — the last of June. Should the weather prove unfavorable for hay-making when the rye is at its best, and it stands a little too long, it will make very good feed for horses; and should the weather, as was the case this year, continue bad, the rye will still be valuable for bedding, either for home use or for sale. As a last resort, I have allowed it to mature its seed; but some farmers would plough the crop in, and have another growing in its place immediately. The present year I had about one-third the area of the tillage-land in winter rye; and, owing to the rainy weather in June, three acres were allowed to mature seed. It must be seen that this is a very safe and handy crop to have growing, especially as its principal growth is made during those portions of the year when the ground would otherwise lie idle.

It may follow grass after haying, even after cutting the rowen; or it may follow any of the spring grains, whether they were cut for fodder or allowed to ripen; may be put in after potatoes, either early or late; may follow millet, fodder-corn, or field-corn; and it will, in either case, be out of the way the following spring in season for almost any crop the farmer may desire to plant or sow. No soiling-crop has gained public favor more rapidly for the past few years than winter rye; and yet I believe its cultivation is destined to increase many fold.

Winter wheat sown at the rate of from two to three bushels of seed per acre will produce fodder that is relished by cattle even better than rye. It is more leafy, a little later to mature, is eaten better than rye when advanced to blooming, and comes in as the second green crop in spring. A bald variety is to be preferred, as it makes a smoother fodder than the bearded sorts. The higher cost of seed-wheat is now against its use as a fodder-crop; but when New-England farmers learn that it is as sure a crop here

as at the West, and that it will yield as many or more bushels per acre than rye, the scarcity of seed will no longer be an objection to its use.

The earliest spring-sown crop I have grown is spring rye. It is perfectly hardy, and should be got in as early as the ground can be fitted for receiving the seed.

Should the ground freeze hard, or be covered by snow after the rye comes up, it will do very little harm, except by retarding the growth. I have sown four bushels of seed per acre; but if the land is rich, and the weather favorable to growth, a smaller quantity would be as well, as a very thick stand is liable to lodge before getting its full growth.

Spring wheat, oats, or barley, either separately or mixed, may be put in to follow spring rye. I prefer keeping them separate, that each crop may be cut and fed, or made into hay, while in its very best condition.

Oats are more hardy than wheat or barley, and may be sown as early as spring rye, or as soon as the earth will crumble behind the plough. They may be sown, at intervals of a week or ten days, till the weather is warm enough for planting corn. If sown much later, there is danger of loss from rust and blast. Four to six bushels of seed will make a fine growth, which is easily cured in favorable hay weather.

I would never sow grass-seed with oats; but, if the mixture be made, four bushels of oats would make a heavy seeding. Barley-straw is softer than oat-straw: consequently thinner seeding is required. Three bushels on rich land will cover the ground heavily. Barley, being more tender, should be sowed a little later, — after the ground begins to get warm. It will also stand hotter weather without rusting, which is a point in favor of later sowing.

I have the past season been experimenting in a small way with a variety of beardless barley, — the "Nepaul;" which, if it will stand up well, and make as vigorous a growth, would be much more desirable than the bearded varieties, that in their green state cause some cattle considerable annoyance. I am not prepared to express a very decided opinion concerning it, from a single year's trial. A good beardless barley would be very desirable for producing fodder. Of the bearded barleys, I much prefer the two-rowed varieties, as they grow taller, and make a heavier growth.

As soon as the weather is fairly warm, it will be time to plant some variety of corn for feeding after the spring grains. It has been my practice for many years to grow corn specially for fodder, planting either sweet-corn or some of the large Southern or Western dent varieties. I have, early in spring, sown Western corn broadcast at the rate of eight bushels or more per acre, and mowed the fodder when but a few feet high, or long before it showed signs of blooming. I have planted it in drills at the rate of forty kernels per foot, and also quite thinly, so it could attain nearly its natural size. I have also planted sweet-corn both thickly and sparingly, but am beginning to doubt if there is any thing more profitably grown in the fodder-corn line than a vigorous growing variety of ordinary field-corn, planted on rich land as thickly as it will produce good ears. I found my field-corn producing this year at the rate of fourteen tons of fodder per acre (weighed after the stalks had become considerably dry, and the ears ripe enough to husk for seed); while the same variety planted thickly, though weighing while very green two tons per acre more, was lodged badly, and the bottom considerably injured by rotting. When the field-corn was at its heaviest (the ears just beginning to glaze), a given area produced a much heavier crop than did the fodder-corn, and, fed with the ears on, was more relished by the cattle. Corn grown by field-culture thinly enough to produce ears is longer in fit condition to feed than if grown very thickly; while if there is a surplus, as there always should be to insure against drought, the remainder left over after the season of green feeding is past will be much more easily cured, as well as more valuable for winter storage. Until I find cause for changing my mind, I shall in future plant no corn specially for fodder in any of the popular ways, either broadcast or thickly in drills, but will plant for a full crop of ears, and not hesitate to cut it when it is most needed. I believe an acre of field-corn can never produce more flesh, milk, or butter, than if cut when the kernels are just passing the milk stage, and beginning to glaze.

The crop next to receive attention after corn is millet. This is one of the most valuable forage crops a New-England farmer can grow. It is as good as ordinary English

hay, will produce upon light lands much heavier crops, and can be grown in a very few weeks.

It can be sown after winter rye, spring grain that has been cut for fodder, and on sod-land, after taking off a crop of hay. Like corn, it is a hot-weather plant, likes a warm, sandy loam, and should not be started till the days begin to grow hot. Sown from the first week in June till the middle of July, a full crop may be expected. I refer now to the common millet with a green head, and the purple-headed Hungarian grass. The golden or German millet requires a longer season by two or three weeks, and makes a much heavier growth. This will grow after winter rye is cut for hay, and will be off in season for sowing rye again, or to seed down with grass. I grew four tons per acre of dry fodder the past summer, after a crop of rye estimated at more than two tons per acre.

A bushel of seed is sufficient for sowing an acre; though a little less may be sufficient of the German variety, supposing the seed to be fresh and good.

When the season gets too late for planting corn or sowing millet, and I find I have any land that would otherwise lie idle, I commence sowing barley for cutting and feeding green in October and November, after corn and millet would be injured by frost. This may be sown after early garden crops are removed, after early potatoes, spring grain of all kinds, early corn, and early millet. If sown any time in July, a full crop may be looked for; and, in a fairly favorable season, much of it will be headed out, if sown through the whole of August.

It occasionally rusts a little, though much less than fall-sown oats, and it may lodge somewhat if the land be very rich and the season moist; but it will generally make a satisfactory return for all it costs. I commenced growing it four years ago, and have increased the acreage each year.

Spring rye and spring wheat have both made good crops with me, sown in the fall; but my experience with them has not been as extended as with barley. The past two years I have sown, during August, barley and winter rye mixed (half of each), at the rate of three bushels to the acre, and with much satisfaction. The barley should head out a little, while the rye should make a heavy undergrowth, together

yielding a quality of feed for late October and the first half of November that can hardly be excelled.

The season is at this time so far advanced, and the weather so cool, that, if cut and left in the swath, it will keep well for several days, or it may be stored quite deeply upon the feeding-floor, without heating enough to injure it. I finished feeding rye and barley this year after the middle of November, and previous to that date had fed very little cured fodder of any kind; although there are but about five acres of pasture for twenty-five head of cattle, and the mowing-fields are never fed.

The rye sown with barley, and cut in the fall, lives through the winter, and makes a full average growth the following season.

All these green crops are cut, and hauled to the barn, and are fed at regular hours, morning and evening. It is the aim to give each animal all it will eat up clean, and have a good appetite for more at the next feeding. In stormy weather, or when any thing interferes with cutting in the field, dry fodder of some kind, previously stored, is given instead.

With such a variety of different kinds of fodder coming along from May to November, the cattle rarely fail to eat with a relish. There is seldom the excessive flow of milk, as from feeding in the best pastures in June, or good mowing-fields in September; nor is there ever such shrinkage as during the droughts of July and August, the frosty weather of November, or the backward months of April and May, with the hay-mows almost empty, and possibly the pocket-book more so.

Any crop that overruns present needs is cut when mature, and made into hay; and, so long as it is being handled, it is fed from at the barn, either green, wilted, or dry, as happens to be most convenient. English hay, if I have it, is fed just as freely in summer, if needed, as in winter. I am seldom more anxious about a full supply of fodder than a suitable place for storage. I have been increasing my storage-room almost every year, and am still frequently compelled to put something into stacks.

Although I consider English grass a valuable crop to grow on some kinds of land, I have this year had only about four acres; and the field upon which it grew is now ploughed for

corn next year. The poultry-yard, some half-acre in extent, is the only ground on the whole farm, exclusive of pasture, that has not been turned by the plough the present season, while more than half of it has been ploughed or thoroughly cultivated twice.

A few days ago I cut the following paragraph from "The New-England Homestead:" —

> "A graduate of the Massachusetts Agricultural College, whose name is known to all our readers, and who is at present an exile from the Old Bay State, writes in a private letter; 'It is my intention to own a small farm in Massachusetts, sooner or later; and my whole object will be the study of agriculture, in its various branches, from a purely practical standpoint. I maintain that an average Massachusetts farm can support a cow to the acre; and this is one thing I shall demonstrate.'"

"Perhaps it can," adds "The Homestead;" "but it is very certain that not many of them do."

My own experience convinces me that this is not too high a standard. My farm has grown fodder enough to keep an animal per acre, and is now producing a considerable portion of the grain consumed, and also the seed required for sowing and I am sure that I have by no means reached the limit of production. Indeed, I sometimes feel that I have hardly begun to realize the possible productive capacity of those twenty-six acres. A considerable portion of the land now lies idle several days or weeks every year, for want of a little more help or a little closer calculation.

I grew a crop of weeds after rye this year, that I was ashamed of; and I have had twelve acres of idle land this fall that might have been now carrying a promising crop of winter rye. Two crops per year does not come quite up to my ideal. The acreage the past year, as nearly as I can estimate, has been 9 acres winter-rye, 7 acres oats, 5 acres millet, 4 acres corn, 4 acres English hay (first crop), 4 acres rowen, 9 acres barley (for fodder), 1½ acres for grain, ½ acre winter-wheat (part cut green, and part left to ripen), 1 acre potatoes, 5 acres rye (sowed for next year's cropping), 3 acres barley (sowed with rye for this year's cutting), 7 acres seeded to grass, and 1 acre in garden: in all, 66 acres.

The nearest approach I have ever made towards obtaining the full use of an acre of land through the whole year was with an orchard. It was sown with winter rye the previous

fall; and, the spring being early, it was ready to begin to cut and feed the first week in May. About the 10th it was finished; and the ground ploughed, manured, and immediately sown to oats.

You can readily believe that these were at their full height and in bloom the 10th of July. At this time they were cut and made into hay, the ground again ploughed and manured and sown to barley. The barley grew about two and a half to three feet high, was well headed and ready to cut the middle of September, or in season to be entirely out of the way of picking the winter apples, which made the fourth heavy crop of that season. I then had nearly the whole of October for seeding again with winter rye. That I did not do so, I suppose, may be taken as evidence that I have a little more land than I can fully use.

By the old system of farming, where the main object was to get out of the land all the fertility possible without carrying any thing back in return, one crop in a year was about all the land would usually bear; but, by the system I have partially adopted, the number of crops that can be profitably grown is limited only by the length of the season.

Few of us, I fear, realize how quickly most of our annual crops are grown, and how much of the time in each year our land is absolutely idle, or at best only producing worthless or noxious weeds.

Indian corn occupies the land longer than any of our staple crops; and yet, if planted by the first of June, it should by the middle of September be sufficiently ripened to cut up, and carry from the field. There is ample time in nearly every portion of Massachusetts to take off a crop of rye before planting, and to put in another after the corn is harvested. The chief difficulty is in being ready to do all the work at the proper time. The Early Rose potato may be taken off in season for a full crop of barley in the fall, and any variety may be followed with rye for the next year's cutting.

Our hay-crop is grown in little more than eight weeks, and may be cut in ample time for obtaining a full crop of millet before the autumnal frosts. Winter rye, winter wheat, and all the spring grains, if allowed to go to seed, are ready to harvest throughout Massachusetts in July; and, unless

the ground is successfully seeded with grass, it usually produces little except useless weeds the remainder of the season. Is it not, then, a wiser economy to grow valuable forage crops at the rate of two or three tons of dried fodder per acre than to give the land over to such weeds as barn-grass and Roman wormwood?

How many of us would be willing to hire money at six per cent interest, and keep it on hand nine or ten months, for paying a debt that will not become due till the end of that period?

One reason why we so dread a mortgage is because the interest is accumulating against us, and growing bigger nights and Sundays; but, if the property upon which interest be paid is constantly productive, then a mortgage may not necessarily be feared.

The grand mistake that New-England farmers are making is in carrying, in their names, too much land that is lying comparatively idle. They are paying interest and taxes on barren fields which ought to be producing valuable crops, and they pay interest and taxes on empty buildings that ought to be filled by the crops from these barren fields. They hire land, or (what is the same thing, or worse) buy land with money hired at high rates of interest, pay as high wages for labor as enterprising mechanics and tradesmen pay, and then employ this land and labor in growing crops which would disgrace Nature, were Nature left to have her own way. It is true, the time has been when a liberal income could be secured by cropping wide areas of New-England soil, but that time is passed; and the sooner farmers realize that fact, and learn how to adapt themselves to the changed conditions, the better it will be for them, and the sooner will New England be able to regain the proud position so long held, but which has been gradually slipping from under her feet.

I think I have never found a hundred-acre farm in Massachusetts that might not make two fifty-acre farms, each capable of producing more than the whole does now; and the average farm may be divided and subdivided I know not how many times, before its fullest productive capacity will be reached.

I have for a few years been endeavoring to increase the

profitable productive capacity of Pine Hedge Farm, but have never yet been satisfied that I had reached even half way to the maximum point. A great deal of labor has thus far been annually expended in improvements which should pay quite as well a hundred or a thousand years hence as to-day; and there is much similar work yet to be done.

The present season, more than half of the stone wall which bounded the highway on two sides of the farm has been carried gratuitously to fill a low place in the highway, and make it possible for a team to haul a full load where only a part of a load could be hauled before. Removing such brush and brier-covered old walls not only adds much to the beauty and park-like appearance of a country-place, but it also makes a very marked difference in the cost of working and manuring the adjoining lands, while it increases to a considerable extent the available area. I have alluded to the wastefulness of carrying unproductive property, and paying its interest and taxes; but I fear, that, as a people, we are paying a self-imposed tax upon our property which few of us have begun to realize. I refer, of course, to the cost of maintaining, at an enormous annual expense, our farm and street fences. We have fenced out our neighbors' cattle, our neighbors' chickens, and our neighbors' children, until we are all in imminent danger of forgetting what the rights of neighbors are. The cattle-drover and the man who pastures the highway seem to have little sympathy for the villager who leaves the gate ajar; and the small boy who is nimble enough to scale the orchard-fence, and retire with well-filled pockets, is by no means a bad fellow in the eyes of those who wait outside to divide the spoils.

It is said that good fences make good neighbors, which is true, if those fences surround lands that are to be used as permanent pasture; but I believe the best neighbors live in those towns and villages where all fences, except those around pastures, have by mutual consent been discarded. In my estimation, the moral effect of a high board fence going up between the little quarter-acre lots used as village homes is any thing but good.

I have, perhaps, as many sorts of neighbors to deal with as any average farmer; but I have no neighbor that is not a better neighbor now than before I took away all my gates

and fences along the line of the highway, and rendered my whole farm as open as a village common.

Nine-tenths of all the fences in use are but the relics of feudal ages, when cities were walled, and individuals made their homes in castles. Our fence laws are based upon a correct principle, which is, that the owner of cattle, horses, sheep, swine, and poultry, shall restrain and prevent such animals from injuring the person or property of others; but the customs of our people would indicate that it is the duty of each to fence, not his own cattle in, but his neighbors' cattle out, and that any neglect in this direction is a risk he runs at his own peril. And so we go on, year after year, building expensive fences of stone, iron, and wood. I wish I could convey to you some faint conception of the enormous tax we as a nation have imposed upon ourselves by attempting, against all authority of law, to fence our neighbors and their cattle and other animals out. If I tell you that the fences built in the United States have, according to the best authority, required an estimated expenditure of the sum of two billions of dollars, you may be able to remember the figures, but you cannot readily comprehend their significance.

Two billion dollars represents a good deal of hard work — a great many hours spent in hot weather and cold weather splitting rails, sawing boards, cutting and setting posts, digging, hauling, and lifting stones — and a great deal of house work, — boiling, baking, washing, and mending for the men and boys who have spent a considerable share of their lives in building these fences.

Do you know how long it would take one of you to count a million of dollars? Supposing you are able to pick up and count correctly one dollar every second, and should count steadily ten hours per day for a whole month of working-days, you would still have dollars enough uncounted to keep you busy two Sundays; and should you continue counting at the same rate, day after day, week after week, and month after month, for fifty years, you would not have counted one-third the cost of the fences which have been built, and are now standing, in the United States. I have not been able to examine thoroughly the census returns for the year 1880; but if the ratio of increase in the value of fences, animals,

and crops, has been maintained since the census of 1870, then the figures will read something like this: —

Value of live animals, including horses, mules, cattle, sheep, and swine	$1,942,800,000
Value of the fences	2,000,000,000
Value of the annual farm and garden crops grown	2,820,000,000

I have shown you how utterly impossible it is for one to comprehend the full significance of these large numbers. Let us reduce them by cutting off the seven right-hand figures, retaining, however, their relative proportions. The statement will now read like this. It requires on an average, throughout the whole of these United States, two dollars' worth of permanent fence to keep one dollar and ninety-four cents' worth of live animals from eating, trampling, and destroying two dollars and eighty-two cents' worth of farm and garden products. With such a standard of individual and political economy, is it any thing to wonder at, that a great many men and women in this country work very hard, and have very little to show for it at the end of the year? If political economy is a study too deep to be introduced into our common schools, then is it not high time that the State gave its support to at least one agricultural college where farmers' sons can be instructed in the relation and bearing of such figures?

We laugh at the simplicity of the Chinese, who built their single line of stone wall on a border of their territory; but I fear we are going to make a future generation smile or groan at our foolishness in covering over the face of the whole country with walls and fences like the lines on a checker-board. You may say that these fences are to be viewed in the light of permanent improvements. I cannot accept the proposition. The tendency of the age is to render, sooner or later, nine-tenths of these fences as useless as the Chinese wall, and a public nuisance to which that wonderful piece of masonry is no comparison. It has cost very nearly as much to get rid of the stone walls on the cultivated portion of Pine Hedge Farm as the original cost of building them. You may say that these fences are a work of the past, and are not a burden to this generation. Let us see about that. Mr. Orange Judd, about two years ago, pub-

lished in "The American Agriculturist" an estimate of the present *annual* fence tax upon the people of this country, and found, that, including cost of repairs and rebuilding, together with the interest and taxes on the same, this annual outlay represents a sum that would be sufficient to pay all the cost of our army, navy, and general government expenses (including pensions), and leave enough balance to pay every cent of the interest on our national debt. This, remember, is our yearly payment, and was estimated when the rate of interest on the public debt was much greater than it is now. No American citizen can afford to excuse frauds, or overlook corruption among government officials; but what comparison do the losses in this direction bear to the self-imposed burdens growing out of this old custom of fencing our neighbor and our neighbor's cattle out? The custom requires millions to build and support fences, who have no animals to restrain. Let us think of this matter seriously, take it to the meetings of the farmers' club, and see what can be done towards lifting this burden from our shoulders and the shoulders of those who will follow us.

In barbarous countries, animals run at large, and men respect no bounds. A civilized people can afford few fences.

The man who turns his cattle at large, to roam over the fields of his neighbors, may consider himself civilized; but the act is certainly very uncivil.

Cutting food in the fields, and feeding it in stables, prevents all waste from tramping of feet, the defilement inseparable from pasturing, the loss of food from lands under-fed, and the greater loss from insufficient food in seasons of drought. Field-crops, green or dry, judiciously fed, are consumed with little or no waste: while the farmer who adopts this method insures himself, to a considerable degree, against risks (such as bloat from over-feeding, as where cattle are turned into fields of rank clover); against injuries to the udder and teats of cows roaming in rough bush-pastures, the over-heating of animals in excessively hot weather (a common source of trouble in the dairy-room), injuries from flies and other insects, which are a source of constant torment to cattle at pasture; and also against sudden or severe changes of weather.

He will also find that manure collected at the stable, and

carted to the best tillage-land, will bring him a far greater return than if dropped among coarse weeds and worthless bushes, or left to dry upon the surface of the very best pasture.

Good pasture, when it can be had, is unexcelled as food for cattle; but the season for the best pasture-feed is very short, especially in unfavorable years. After-feed in mowing-fields can rarely be pastured with profit, where the mowing-machine can run unobstructedly; certainly not if the cost of fencing is taken into the account.

Growing forage crops as a specialty will enable farmers to double or quadruple their stock, or divide and subdivide their farms. It will enable a State to increase its farm-stock and its rural population several fold.

A denser rural population will improve the social character, and increase the political influence, of country towns. The system well carried out will greatly diminish the cost of ordinary operations, while the net profits will be increased.

The difference between the cost of ploughing, cultivating, and harvesting, in large or small fields, may make all the difference between profit or loss.

At Pine Hedge Farm the plough can now turn furrows sixty rods in length; and whether using the plough, harrow, or cultivator, a day's work in the field always equals two days spent in the small garden-patch.

I cannot leave this subject without alluding to the economy of having good tools for working large, smooth fields. The production of forage crops as a specialty is best adapted to plain, easily-worked land, such as largely prevails in this section of the State; and no one should expect the best results, unless he first puts his land into good condition for running the improved modern implements of tillage. The swivel-plough will leave a smooth, level surface, requiring neither cross-ploughing nor cross-harrowing to fit it for the reception of the seed. The disk harrow will enable one to put upon a recently-turned sod any crop which would formerly have been considered only adapted to an old cultivated field. The machines for sowing grain and grass-seed will do in an hour work that without them would require several hours of hand-labor, while the machines leave the seed much more evenly scattered.

The smoothing-harrow, with its seventy-two fine steel teeth sweeping a breadth of ten feet, will cover the seed; while the iron roller, to follow, will settle the small stones, and smooth the surface so quickly, that one accustomed only to the old-fashioned tools and methods would almost doubt if he had really been at work.

I will call your attention to but one other point. I know that some of you have mentally asked the question, Where is the manure coming from to dress all these acres kept so constantly under the plough?

I may say, that, for several years past, I have made it a rule to apply a dressing for every crop put in, whether it is once, twice, or three times in a year. That portion of the farm lying near the stables is manured chiefly with animal manure; while that at a greater distance is dressed with purchased fertilizers solely. I was once prejudiced against purchased fertilizers, because they appeared unreliable; but since the manufacturers have learned their business better, and the State has set a guard over their operations, so that it has become possible to buy honest fertilizers that are made and sold upon business principles, as other commodities are made and sold, I have come to consider the artificially-prepared, concentrated fertilizer the powerful lever by which the intelligent farmers are going to be able to completely upset and revolutionize the prevailing sentiment concerning New-England agriculture.

When the laws which govern plant-nutrition are as fully known and observed as they should be, I doubt not that our Massachusetts farms will bear constant cultivation and cropping, without recourse to outside influences; but I know that even now a run-down farm can be speedily and economically brought up to a productive condition by using its own resources, supplemented by well-selected commercial fertilizers.

It is claimed by some, that the growing and turning-under of green crops is the cheapest method of improving a run-down farm; but, where forage crops are in such demand for cattle-food as they are in Massachusetts, it does not appear to be the better way.

If the ideas I have brought to your attention this afternoon are not visionary, but practicable, and worthy of extended consideration or general adoption, then I think we

may look forward to the future agriculture of New England with feelings full of hope and full of gladness.

QUESTION. I should like to ask the gentleman if his neighbors have discontinued their fences on the street.

Mr. CHEEVER. Not all of them, but they are working that way. There are no cattle going on the street now where I live.

QUESTION. What would you do if you lived on a street or road where, in the fall of the year, droves of cattle to the number of five hundred were driven by every week or two?

Mr. CHEEVER. Well, I will admit, that, if I had been so situated, I do not know but I should have waited for somebody else to have pioneered in this work of creating public sentiment against fences. But I know this, — that drovers are more bothered now in driving their cattle through villages, in passing into Brighton or out, where there are fences and open gates, than they would be if there were no fences and no gates. An animal dodges in at a gate; and, having got in, the herd going on, the animal keeps along with the herd, inside of the fence; and then there is a time in getting him back again with a dog, a boy, and a man. It takes a long time, and it is a great bother to the drovers. Cattle, like partridges and rabbits, and all animals, will follow paths naturally. You can drive a herd of cattle across any pasture or common where there is a cart-path; or you can lead the master-cow almost anywhere, and all the rest will follow: but, if you drive a herd of cattle along a highway where there is a gate open occasionally, some will very likely dodge in.

Mr. ——. Some years ago we took away about forty rods of fence on our farm, and left it two or three years. In the fall of the year we are in the habit of having very large droves of cattle come through our place; and the drovers cursed me so for leaving my land open, that I finally concluded to put up my fence.

Mr. CHEEVER. The law obliges the drover to have sufficient attendants to take care of his herds; but if, having a sufficient number, an accidental step is taken into any person's land, the drover is not responsible. We have depended upon fences so long, that we imagine we can turn a drove of

cattle loose into the street, however wild they may be, and start them right off in a drove, when, if they were horses, we should hitch them together. We would not attempt to drive horses as we drive cattle. These are matters of habit.

Dr. STURTEVANT. A drove of cattle passes my place once a week regularly. They had got into the habit of breaking in, and running over my fields. I simply prosecuted the drover, and got judgment against him, and told him I should hold that judgment over him, and, if his cattle troubled me again, I would enforce it. Since then there has not been an animal in my field.

Mr. CHEEVER. When I took down my fence, I had good reason for it. I had a neighbor who persisted in feeding his horse in the highway directly opposite where I live, and I used to drive him out when he got into my mowing. One day, when I was driving him home, I met my neighbor, who was not in a very good condition to feel well, and he made unpleasant remarks. I did not make any reply; but I have not had a gate or bar up since, and, as I said in my paper, I have not a neighbor who is not a better neighbor now than before I removed my fences. I have had no trouble with the neighbor to whom I have referred since. He kept poultry, and I feared a little trouble from his hens; but within two or three years Massachusetts has passed a law making the owner of hens liable if they damage others. The complaining party, after giving due notice, can bring an action against a man for not restraining his hens. As this neighbor lives directly opposite to me, and as I own the land nearly up to the sill of his barn, and have given him permission to drive across my land to get his manure out, I did not want to talk to him about hens, because it is not a pleasant thing to talk about. I planted a strawberry-bed as close up to the line as I conveniently could, and I have let him have a good share of the strawberries, and his hens are shut up. If we can see that our fences can be dispensed with, you see how great a tax we are relieved from. The little details each one must settle for himself, according to his own particular conditions. If any man prefers to keep a road-fence, he has a perfect right to do so. I had one night four colts in a field of oats; but, when I came to figure up the damage, I found that it did not amount to more than two dollars, including the time spent in

catching the colts, and the cost of keeping them. The owner was perfectly satisfied with my bill, and so was I. That is all the damage I have had in five years.

QUESTION. Will you tell us how you got rid of all those walls? What is the best way?

MR. CHEEVER. There was a swamp-lot near by, from which muck had been carried for two generations into the barnyard for compost; and it left a ditch fifteen or twenty feet wide, full of water at times, and made a harbor for muskrats. A ditch was dug around the swamp, filled with stones, and covered over, which drained the border, and gave us a chance to drive on the meadow a little nearer the main ditch we wished to fill. Then another ditch, that ran in towards the centre, was cleaned out in a dry time, and the material thrown on to the bank, shovelled back, and allowed to lie there until it dried in the atmosphere sufficiently to allow driving on with a light team. We then drew in stone, and filled the ditch. Then we commenced the other side of it, and dug another ditch of the same size, just far enough off to leave a bank to keep the water from flowing in, throwing the mud, which is from four to six feet deep, on top of the stones. That left another large hole to put more stones in. Those walls were gradually disposed of in that way. That kind of work was carried on, until there is not room now to dig another ditch. That is one way of getting rid of stones, and it is a good way. This sample of millet grew on that ground, after a good crop of rye, where I have sat evenings, and shot musquash swimming in the water.

QUESTION. How deep did you put the soil on?

MR. CHEEVER. From one foot to nearly two feet. Eighteen inches to twenty inches is what I would recommend in meadow-land, to cover small stones. The first stones that were drawn were covered too shallow, and the plough touches them occasionally.

QUESTION. What was the whole expense?

MR. CHEEVER. It took about all the leisure time of the regular help on the farm for some thirty years to clear off all those walls, get out the rocks, build the drains, and make the farm fit to till.

QUESTION. How much would it have cost if you had had to hire it done?

Mr. Cheever. I do not know. The farm is my home. I think considerable of it. Those improvements were our knitting-work. We need a certain amount of help to do our regular farm-work; and there are some leisure days and odd hours, and days when some farmers would go to the store to smoke, and talk politics, when we have been doing that job. Looking at it in that light, it has not been very expensive.

Mr. Shaw. Suppose you had not such convenient meadows to put your stones in, what would you do with them?

Mr. Cheever. If land needs underdraining, a great many can be used to build drains. I think stones can often be put in drains better than anywhere else; and it is a profitable way to dispose of them.

Mr. Shaw. Suppose your farm does not need draining?

Mr. Cheever. Generally you do not have many stones on farms which do not need draining. On light, sandy land, stones are not often abundant.

Mr. Cushing. I have been deeply interested in the paper which has been read. I would like to know if Mr. Cheever has kept books, so that he can tell us any thing of the relative cost of keeping a cow on a farm like mine, where it now takes about three or four acres to keep a cow, instead of one, as he has told us, — whether it would be a matter of economy for me to throw out to common seventy-five acres, and try to keep my cows on twenty-five acres. I believe my brother milk-producers in Plymouth County would share my interest in that question.

Mr. Cheever. I have no hesitation in saying that good farming pays better than poor. If you want to make the most money from every thing, and make your milk in the cheapest way, I believe that the method I have spoken of this afternoon, gradually adopted, — gradually enough to understand it, and become acquainted with it, — will bring the cost of your milk at a lower figure and with more profit than you can get it by depending upon pastures in the old way, feeding mowings, and following along in the old New-England methods of the past. That is my conviction.

Question. Will you give these gentlemen some idea of the expense of running your farm?

Mr. Cheever. That is a difficult thing for me to do. I have employed this season two men constantly, and have not

hired any extra help more than half a dozen days. By double and tripple cropping I cultivate, as you have seen, sixty-six acres. We have ploughed twenty-six acres once, and more than half of it twice. I will say that I have done nearly all the ploughing myself. I always plough all my greensward myself, and this season have, with a subsoil plough and three horses abreast, gone over about one-fourth of the farm. I have done all my mowing with the machine, and most of my raking.

QUESTION. You carry on your farm with your own hands and two hired men?

Mr. CHEEVER. Yes, sir. My son, who was at school, was at home on his vacation, and he helped me a little during haying; but his hands were soft. He had a great deal of studying to do, and I could hardly count it much. My editorial work, and calls from friends, take a great deal of my time; but two men, with what work I could do, have been all I have needed. We do not have to travel half a mile for every load of manure. One great difficulty with large farms is, that too much travel is required in getting to work.

QUESTION. You spoke of using fertilizers on portions of your farm that are distant from the house: are we to understand that you used no manure on those portions, except commercial fertilizers?

Mr. CHEEVER. On a certain portion of my land I have used fertilizers only for the past six years; and it has been cropped once every year, and twice a year most of the time.

QUESTION. Do you find your crops as good where you use the fertilizers as you do where you use manure?

Mr. CHEEVER. I do. And every acre so treated has been growing richer and stronger under this system. To test the matter, and see whether the fertilizers had all been used up, I sowed half a dozen acres, the past season, to rye and oats, without applying any fertilizer at the time, and in both cases got a full crop; but of course I could not repeat such an experiment often with success.

QUESTION. I would like to ask you if you would sow the land with grass, that you have used fertilizers upon for two years in succession, expecting to get good crops for two or three years.

Mr. CHEEVER. I should never sow land down to grass without manuring with something at the time.

QUESTION. With something besides fertilizers?

Mr. CHEEVER. No, sir. I am not afraid to depend upon bone, or other good fertilizers, wholly.

Mr. KING. I have used fertilizers in seeding down grass-land. I put on from twenty to twenty-five dollars' worth per acre; and my first crop is heavy. I know of one field that has been in grass for four years, on one side of which a fertilizer was used when it was seeded down, and on the other side manure, only about four cords to the acre; and there has been no second crop raised on the side where the fertilizer was put when the land was seeded down. Previously the land had been manured alike. That is one instance where the fertilizer has failed with me. Still, I believe in using fertilizers; and with us it has brought manure down from ten dollars per cord to five dollars, and we have got a great advantage in that direction. But I am satisfied that there are certain crops where I have been as successful in getting as good a yield with the use of fertilizers as I could with almost any kind of manure, say eight cords per acre. I live in an onion neighborhood. We raise a great many onions in a good onion year. But I have my doubts about the use of fertilizers on grassland. I don't think the strength remains in the land. I think it nearly all, if not all, goes out in one year. I am aware that people differ; and all I know about it is from my own experience.

Mr. CHEEVER. I cannot tell what the future may bring: the past has been satisfactory.

Mr. KING. I understand you have used it year after year?

Mr. CHEEVER. For six years.

Mr. KING. I understand you do not sow your land down to grass: you keep it up all the time?

Mr. CHEEVER. I have sowed down six acres this year, and used largely bone.

QUESTION. Do you think subsoiling pays? and how does it compare with using clover as a deep-rooted crop for the same purpose?

Mr. CHEEVER. I do not know how strong the clover-root is; but I think it would not have got down very much in some of my soil if I had not subsoiled it. My subsoil plough is a steel plough, with a colter, but no mould-board.

It has a lifter that runs under the ground, some four inches wide, and it is a good pull for three horses. It lifts the ground, and starts up the cobble-stones, which for fifty years have just caught the point of the ordinary plough. I can get a good deep soil by using a subsoil plough.

QUESTION. How deep do you run a subsoil plough?

Mr. CHEEVER. One foot deep. In my method of operation, it does not cost any thing extra. I never subsoil sward-land: that would require two teams, or unhitching from one plough, and hitching on to the other. I subsoil after corn, where I am going to sow oats in the spring. I want to lighten the ground up. I can do that just as cheaply with the subsoil plough as with an ordinary plough. Then I put on an Everett & Small cultivator, with three teeth, that runs as deep as a plough if you will let it down, and do the work a great deal faster. I use that instead of any other plough; and really it does not cost me any thing extra to subsoil, when I can get about it, and have every thing ready.

QUESTION. If you were raising grass exclusively, do you think it would pay to subsoil?

Mr. CHEEVER. It does not cost any thing extra as I do it; but it does pay to put a piece of land into condition, so that you can plough it all eight inches deep.

The CHAIRMAN. I believe in the doctrine that the lecturer has advanced with regard to stone walls; but it would impose an onerous tax on some of us. I have a farm of fifty acres adjoining my friend Russell here; and on it there are miles of stone wall from six to eight feet high, and they are from four to thirty-five feet wide [laughter]. I don't wonder you laugh and doubt; but here is my friend, who saw them a good while before I did. I did not build the walls: you understand that. You could drive a four-horse coach on the top of the wall: it is just as level as this floor. It would be imposing too great a burden upon me to make me take those walls off: I never should do it. I agree with Mr. Cheever, that it would be desirable to have the thing done; but I do not know how we are going to do it. It is astonishing to look at the walls on my place. I do not believe that it was good husbandry to build them; but I have got them, and I do not know how to get rid of them. My friend here will not take them off: he has enough of his

own. He has been at work all the fall getting off some of his old wall that is not more than three feet wide, and putting the stones under ground. I should be glad to give my walls to him, if he would take them off; but he won't do it, and I certainly will not do it. I believe in the doctrine of no fences.

I will not pursue that subject any farther, because I want to call up the subject of wheat, which has been alluded to. If Mr. Grinnell is in the house — he knows something about wheat; and I want him to give some facts, and some of his experiments.

Mr. Grinnell (of Greenfield). I am afraid I shall not be able to speak with any definiteness, or with such particularity as you should have; for, as has been remarked by more than one of our speakers, accurate statements are what we want. This guessing at measurements, or giving estimates, is not what we should have.

The matter of growing wheat has interested me in common with other farmers in Franklin County, which is the first agricultural county in the State, acre for acre — with due deference to the Old Colony. I am happy and proud to say that Franklin County raises more wheat than all the rest of Massachusetts; and I was also happy to find that there was a missionary at work down here, in the popular president of this county society, who has been urging the growing of wheat. I believe that wheat may be grown with profit, to a certain extent. Not, by any means, that I would advise any man, or wish any man, to take wheat as his main crop; but our farming in New England, our farming in Massachusetts, is eminently a mixed farming. That is the only way in which we can well succeed. We have, perhaps, some crops rather more special than others; but we must take every thing. We make our butter, we grow our potatoes, our corn (mostly), our rye; and it is, I think, advisable that almost every man should grow some wheat. Every agricultural community — I tell you it is an axiom upon which you may depend — should raise at least a very considerable portion of the materials which are to supply its own people. It is not to be expected, that, with our large population of non-producers, we should, on our own territory, grow wheat enough to support them all; but a certain amount might be profitably grown by many, very many, farmers.

It is difficult to say why it has not been done. I have asked hundreds of times perhaps, at different farmers' institutes where I have been, "Do you raise any wheat here on your farms?" — "Well, no." — "Why not?" Well, the answer will be pretty much like this: "Grandfather tried it, and he never had any luck; and father always said he could never raise any wheat on our land; and I have never tried it." That is about all the answer I have ever been able to get, that the man's father or grandfather tried it, and did not meet with any success. I believe, that, owing to climatic changes, we can have better success in growing wheat now than formerly. You know that in 1838 the Massachusetts Legislature offered a premium for the largest amount of wheat raised on a farm. The following year Massachusetts raised a hundred and fifty-seven thousand bushels of wheat; and for two years it was largely grown. But it must be confessed that it was not at that time successful as a crop. There were many things which interfered with its growth, — there were weevils, there were blights and rusts, there were insects. At the present time we seem to be exempt from these difficulties in this part of the country. I hear no complaint in my own county, or at any of the institutes I have visited, of blight; I hear no complaint of the weevil, the midge, or Hessian fly. Those were the three evils that afflicted farmers in former years. There is occasionally smut, and sometimes rust; but Massachusetts has continued to grow, from 1840 down to the present time, a larger quantity of wheat to the acre than any other State in the Union, and Franklin County shows a greater acreage of wheat than any other county in Massachusetts. You can grow thirty bushels of wheat to the acre just as well as fifteen bushels of rye; and it is a better crop, if you are going to seed down with grain, than rye or oats; and from it you can have the very best flour, if you have mills in your vicinity, and, if not, it will pay to take your wheat a dozen or fifteen miles to a good mill. You will get from your thirty bushels of wheat six barrels of flour, six hundred pounds of middlings, and the straw. The straw is not so good as rye-straw; but you can get about ten dollars' worth of straw at any going price, and make it a considerably more profitable crop than rye.

I know a good many of our very best farmers who never had a barrel of flour in their families, except what they raised themselves. I know one farmer in Northfield, who has been on the State Board, who raises a few acres of wheat every year, and makes his own flour; who never has had less than twenty-five bushels to the acre; who never has lost a crop entirely; and not over three times in ten years has his crop been what you would call a partial failure. I know of another farmer, recently president of our society, who raised ninety-five bushels of wheat from two acres of land in 1880; and the past year he had four acres from which he got one hundred and sixty-eight bushels of the very best wheat. That was land which had borne tobacco. Of course, it was highly manured, thoroughly cultivated, and, from the care and clean cultivation which tobacco requires, the land was in perfect order. There was no foul stuff among it, but a very fine stand of wheat, which sold for two dollars a bushel.

QUESTION. Was it spring wheat, or winter wheat?

Mr. GRINNELL. This was winter wheat. Winter wheat is more generally sown with us than spring wheat. It has been regarded as a better quality of wheat. I know one of our best old farmers whom I have seen every winter coming down through the village from the hills west of the town with his horse and sleigh and a freight of wheat, which he was carrying down eight or ten miles to a flouring-mill. He has done that for fifty years. He never has failed to raise a crop of spring wheat.

QUESTION. What do you consider the best soil for spring wheat?

Mr. GRINNELL. I have grown over forty bushels of wheat, with plenty of fertilizer, on a sandy loam. Either spring or winter wheat requires a good, strong soil. The trouble with farmers in raising wheat has been, that they have not paid sufficient attention to the preparation of the land, and to the manuring. They would sow their wheat as they would rye, and expect it to grow without manure. Now, I undertake to say that the doctrine which Mr. Cheever has advocated here, and which I have always practised on, is the right one, — never to attempt to take a crop from land without previously giving it sufficient nutriment to feed it well. I grow two or three crops of some things

on the same land the same year; but I never put a second crop or a third crop on to land without giving it something, and usually some special fertilizer. I think it is robbery, and a fraud upon the plant, to attempt to raise it upon the *residuum* left from the crop of the previous year or of one earlier in the season. Wheat requires fine tilth and plenty of fertilizers. I use a great deal of plaster (a gypsum) on almost every thing. I find it excellent for pastures, and for rye and wheat. There is nothing that will make clover grow so well.

QUESTION. How much plaster to the acre?

Mr. GRINNELL. I suppose that two hundred pounds is as good as more.

QUESTION. I would like to inquire if an acre of land in a state of fertility sufficient to produce thirty bushels of wheat would not be in a condition to produce certainly three tons of good English hay worth, at the present price, about twenty-five dollars a ton, with a less amount of labor than would be required to produce the wheat and get it to market; making a sure crop for us, that is always in demand in the good old Bay State.

Mr. GRINNELL. In answer to that, I would say that I am not supposing that you put all your land into grass. I am supposing that you have a rotation, or, if not rotation, at least a change of crops. A piece of land that would produce thirty bushels of wheat to the acre would produce three tons to the acre of grass; but then, you could not put all your land into grass.

Mr. ——. No, sir; but if we have a sufficient number of crops to rotate at the present time, and crops that are certainly adapted to our soil, especially in Plymouth County, would it be wise for us to go into a crop where there is uncertainty?

Mr. GRINNELL. Did you ever try it?

Mr. ——. I have never tried it, from the fact that I never had a neighbor or friend who has had success in wheat-growing, and from the fact that there are so many crops which we can produce that are adapted to this soil and climate. I have never felt confidence enough to embark in an enterprise about the success of which there was any doubt.

Mr. GRINNELL. Your president, Mr. Lane, thinks that

wheat can be grown in Plymouth County. Suppose you should try an acre.

Mr. ——. It would cost more than it comes to.

QUESTION. In your opinion, does it follow, if you have some good wheat-land in your county, that wheat can be raised to advantage all over the State?

Mr. GRINNELL. I do not think there is such great diversity of soil in different portions of this State, that you could not find soil here upon which you could raise wheat, as well as in Franklin County. I do not look for wheat-land as they do, perhaps, in England, or in New York, where they raise great crops. We can raise wheat on any good land which has been well tilled and well manured. The best crops have been raised on what has been called first-rate grassland, — often where tobacco has been raised, and wheat followed.

Mr. SESSIONS. What made me ask that question was, that some years ago I tried to raise wheat, — tried it for several years, — and was not successful. I thought I would use land that was a little better than I used for my other crops, so as to get some good wheat; and it came out a failure.

Mr. GRINNELL. I think that much more might be grown than is supposed. At any rate, I think it is well worth trying.

Mr. SESSIONS. An old man in the western part of the State, in the county of Franklin, who had always raised wheat, said to me at one time, that, in order to have a successful crop of wheat, it ought to be sown upon land where it would catch every breeze that came. I think the best wheat that is grown in Franklin County is grown upon the high lands in the towns of Heath, Rowe, and those hilly towns where, perhaps, the land slopes to the south, and yet it gets every breeze that comes from the north. That, perhaps, may have had an effect.

The CHAIRMAN. A pertinent question has been asked here, — what it cost to move those stones. I cannot tell you that; but here is my friend, the secretary, upon whom I depend for all the statistics I want. Perhaps he can answer that question; and, after you get that out of him, you can ask him about wheat; for he has some facts in relation to that matter which it is desirable should be presented at this time.

Mr. RUSSELL. The proper function of the secretary of the State Board is what the woman said was best about children, — that they were to be seen, and not heard.

The CHAIRMAN. But they are to *mind*.

Mr. RUSSELL. Yes, and mind. That is just what I was coming to. In regard to the matter of wheat: I was particularly struck this fall with something that occurred in the course of my experience; and there are several persons here who have heard me allude to it at the institutes. At the New-England fair, they had, among other attractions, Gen. Sherman. Gen. Sherman is from the West, and his ideas of farming are largely drawn from his observation of Western farms. He was very patronizing and kind to us. He patted us on the head, and wondered that we should think of farming in Massachusetts at all; thought it was to our credit that we undertook to cultivate our shallow, cold, and stony soil. He alluded to it as a very praiseworthy and excellent attempt to struggle against the forces of nature. Then he went on to speak of a farm that he had recently visited, and made us unhappy by drawing a comparison between what we got and what they took from the great Dalrymple Farm in Dakota. He said it was forty-five miles long. It was a good deal like that farm that was so long, and ran through so many counties, that the Western man boasted, that, when they mortgaged it, the mortgage became due at one end before they could get it recorded at the other. Well, Gen. Sherman told us of those immense farms, and the vast quantity of wheat in the aggregate that was raised on them. I went away feeling rather sorry that I was the secretary of the Board of Agriculture of such an unfortunate country as Massachusetts; but a few days after, I attended a little town fair in Royalston, — one of the north-western towns of Worcester County that had been stranded upon the hills by the railroads, that have left it one side, — and, while I was looking at the products of that town, I saw a sample of spring wheat, — as handsome wheat as ever the Department of Agriculture in Massachusetts sent out as specimen-seed, — and, while I talked with the man who raised it, I reckoned the value of it. He got thirty-one bushels to the acre; which is about the average yield, I believe, in Franklin County. When I told him what I had reckoned up as his

profit on it, "Why," said he, "you have not got my profit within twelve dollars to the acre." Said I, "How is that?" — "Why," said he, "you have only given me credit for eight dollars a ton for the straw, and I get twenty dollars a ton for every ton of straw I take down to Winchendon, where they use it to pack tubs and pails." I went home feeling a little more encouraged about Massachusetts agriculture, although on a small scale. I had hardly got into my library, when I saw an account of the productions of the great Dalrymple Farm in Dakota. They had twenty bushels of wheat to the acre on the virgin soil of Dakota; and, when they got it to Buffalo, it netted them almost a dollar a bushel: I was thankful that I lived in a country, where, if we could not get at least forty dollars net to the acre, we should feel it was poor business. My neighbor up in Royalston was getting more money for the wastage of his crop than they were getting for the whole production of an acre of land in Dakota. I thought, furthermore, of this great Dalrymple Farm forty-five miles long, or so, without a schoolhouse within a thousand miles of it, cultivated, — *un*cultivated I mean, — cropped, or, rather, robbed, by a lot of savages; for we know perfectly well that men living without homes or families, without any women in the whole country to keep them straight, are no better than savages. I don't suppose there has been a clean shirt or a fine-toothed comb there within a year.

But to come to the matter of walls: I bought a neighboring strip of land this year, partly because it was good land, and partly because there was a lot of tumble-down wall between me and the property. Then the question was, how to get rid of it. I put it in the ground. The way to do it — the way I would do it — is to contract with somebody to dig a ditch three feet and a half deep and three feet and a half wide, and then put the wall into it, setting the larger stones together, backing them with the next largest ones, and then throwing the small ones in to within about a foot and a half of the top. I think I filled my ditch to within a foot of the top. I did not dig it quite deep enough. I would rather have the stones eighteen inches under ground. You can contract with smart men to dig such a ditch as that of mine for about a dollar and a half a rod; and putting the stone in ought

not to cost more than sixty or seventy cents a rod more. That is a little over two dollars a rod for sinking a wall in the ground, and making a good drain in the place of the old wall. I believe that it is worth every cent that it cost. That is all I have to say about it, except this: that I have been sinking walls for several years; and I find that it pays me in under-drainage, as well as gets rid of the eyesore of the wall.

The CHAIRMAN. Now the time has passed which was assigned to another subject. I have great confidence in doctors; and we have a paper coming from Dr. Faxon, who lives up in the land where they grow presidents (in Quincy), who proposes to tell us how to make silos, and preserve ensilage, so that we can all do it.

HOW THE SILO MAY BE MADE AVAILABLE BY ANY FARMER.

BY DR. W. L. FAXON.

To enable a farmer to decide for himself whether *any* process of preserving fodder is a good one, it is requisite that he should possess some knowledge of the constituents of the plant he intends to preserve, and some knowledge of the changes fodder undergoes in the process of curing or preserving; otherwise he cannot tell, for himself, what he may expect as a result of the feeding of it, and consequently what the result of his labor will be. Until within quite a small number of years, it was, as a general thing, the custom in this section to wait until July before beginning haying; for it was supposed the grass became riper, and therefore better fitted for fodder. We know now that this was a mistake, and that early-cut fodder contains more nutriment; for we wish to obtain the nutriment in the stalk, and not in the seed. Then, too, it was customary to cut the grass when the dew was on it, partly, no doubt, because it cut easier; and often a whole day was consumed in drying the water out of the grass, three days being considered none too long a time to properly make the hay. Now, having learned more about grass, and what it is good for, we wait until the dew is off before we cut it; and, with the ordinary farm machinery, the hay is ready to house the afternoon of the day it is cut.

So great a change has been made in this simple thing, because we know both *why* we should do thus or so, and *how*

we should do it. I make these preliminary remarks about our method of making hay to show you that a *system* is one thing; a *method*, another.

Now, there is presented to us a system of storing fodder, which, some of its advocates claim, can be applied almost universally as regards time and season, and kinds of fodder to be acted upon by it. This system is not new to the world, though it is new to America. It has been in operation in Europe, to some limited extent, for a number of years, and with plants well adapted to be acted on by the silo; and under certain circumstances it has, doubtless, many valuable features. This system of storing or preserving fodder can in no sense be called curing it; for curing means preservation in such a manner that no injury can result to the product from changes within itself. The silo system preserves fodder temporarily, but with all the possibilities of destruction from internal changes retained.

Still there is much that is desirable in this system of preserving fodder, if it be rightly applied, the proper season of the year selected to put it in operation, and the right kinds of plants chosen for treatment. Green fodder can be kept for a few months in a condition very suitable for animal food, in a succulent condition too, and within a pit or out of it; and the favor or disfavor the silo system will meet with depends upon a proper understanding of the reason *why* it keeps. So far as my own experiments extend, the results were as favorable as could have been expected. Our experiment with black-grass from the salt-marsh gave a particularly sweet and toothsome fodder. This was because the fodder was fed out when the process of decomposition had reached the saccharine stage, and all the bitter gums or starchy compounds were the most readily convertible into animal tissue or milk. This species of grass could have been easily dried, cured; but the product would not have been of equal value. The second experiment was with branch-grass, also from salt-marsh. This grass makes a good hay when dried; and, although it has some of the bitter properties of the black-grass, yet it is preferable to black-grass as a dry fodder. This lot was allowed to remain in the pit from August until the March following: and, although the cattle ate it, I could perceive no result attending its consumption, to convince me

that I had gained any thing; in fact, I think there was a loss in nutritive materials. My third experiment was with green corn-fodder, planted in July, put into the pit in October, and fed out from Dec. 1, 1880, to March 15, 1881. In all, a period of five months elapsed while it was under ground. Although considerable acidity was developed by the internal changes, yet the results obtained from feeding it were such as to offset any loss experienced in the transformations that had taken place in its primary constituents.

These experiments were made with some of the poorer kinds of fodder; and, so far as I have been able to ascertain, the results obtained from pitting, green, the grasses that are rich in sugar, starch, or gums, have not been such as to warrant any one departing from the old system of curing grass.

If the silo is to come into general use, it must be as an adjuvant to the systems we now employ, and not as a substitute. It must be put in operation upon the right kind of farm-products, and at the right season of the year. Of coarse grasses, rushes, or other swamp products growing wild, we do not now make, nor is it probable we shall ever make, any use as fodder. If we do, the silo is particularly well adapted to them. As regards all the grasses we now use for hay, our sunny skies enable us to cure even the coarsest of them with all their feeding qualities unimpaired.

To understand *why* fodder keeps in a condition suitable for animal food in a silo, something must be understood of the process of decomposition, or rotting, and one must also have some knowledge of the composition of plants at different periods of their growth.

If we mow a lot of green grass, and put it in a heap, it rapidly heats; and after a few days it becomes sour, mouldy, and soon rots into a homogeneous mass, in which the shape and fibre of the grass is undistinguishable. To this rapid rotting two agents are necessary, — air and moisture. The less mature the grass, the more rapidly it rots when these two agents have access to it; and, if a pile of grass is loosely made, the plant contains moisture enough, and there is enough air mechanically retained, to complete the process. If we wait until the grass has nearly ripened its seed before we cut it, quite a large pile can be made; and, although air has free access to the heap, rotting takes place slowly, for

the moisture is wanting in the grass itself; and, should water get in from the outside, decomposition is not rapid, for the stalk of the grass is chiefly woody fibre. The starch, sugar, and gums that made the green grass rot so rapidly have been expended in ripening the seed, and that is fitted to remain for years under ground without decay.

Now we wish to cut our grass green, and preserve it in a moist condition. If we make a pile of grass such as alluded to above, and the heating begins, there are two ways of proceeding if we wish to stop the process. One is summarily arresting it by opening the pile, and exposing all portions of the material to the light and air. The air and sun take out the moisture, and we make hay. If the pile is in suitable shape, size, and place, we compress it still more compactly together, and we make ensilage. By the former process, however, we have so changed the grass, that it is indestructible from any changes that will begin within itself: it has only to be protected from moisture to enable us to keep it as long as we wish. The grass is cured. By the latter process we have only excluded one of the agents needed for the *rapid* destruction of the plant; but we have left the moisture of composition, with which all processes of destruction are possible when working with the peculiarly organized compounds contained in the plant, and we have only *delayed* the decomposition.

As farmers looking for practical systems for preserving our fodder, and the simplest and easiest methods of applying such systems, let us consider the two methods of applying the silo to American farming. We know we can expel the air from a mass of green fodder so completely that it will keep from rotting for a number of months; but we cannot keep the constituents of the mass from changing. The change is constant; and the longer it is allowed to continue after a certain period of time, not yet clearly known, the less valuable the product becomes. We know, however, that among the changes are some of a beneficial character; so that within certain limits loss and gain may be nearly balanced. We can so select the substances to be treated in the silo, that, considering the season of the year when they are to be harvested, the uncertainty of drying the plants in the short and damp days of autumn, the desirability of having some

succulent food for the cattle about to be taken from the pastures, the advantages shall more than balance the disadvantages. Knowing these things, we conclude the silo to be a valuable addition to our farm systems.

We have learned what I may call the mechanical chemistry of the silo; viz., that green fodder in mass keeps because the air is expelled from it, and that the only oxygen consumed in the metamorphoses is obtained from these metamorphoses themselves. We know that the only practical method of expelling the air is by pressure on the top of the mass, and that this pressure can best be applied by stones, sacks of sand or earth, — substances of great specific gravity, — rather than by screws.

There is no question as to the manner of compression; and, having settled that, we ask, How shall we mass the fodder? How shall we make the pit? Shall we make one at all? Most of those who have experimented with the system in Massachusetts have built tolerably expensive pits to keep the fodder in, thinking the circulation of air around the mass capable of causing it to rot, and, to insure close packing, have cut the fodder into very small pieces. I should maintain, that, though such pits may be desirable when the fodder is finely cut, still to keep it an air-tight pit is not necessary; for what air would obtain access to a mass of fodder through the sides of a pit, if it were boarded, or to the bottom, if the bottom be the uncovered ground, would not affect the result. We must not forget that the weight on the top keeps out the air.

This method of applying the system is efficient, and it has many advantages. The pit is kept in permanent form, and may require little work to keep in condition when once made. Such pits are expensive, and many farmers have not the money to pay for one. If, however, a farmer determines to cut his fodder into inch pieces, I shall advise him to build a silo that will last for years, and have it as near as possible to the place where the ensilage is to be eaten.

Now in regard to cutting the fodder. I think those who have advocated the cutting green corn-fodder to insure its keeping may not have thoroughly understood this part of the subject. I do not intend now to discuss all the points of the silo system, but shall only endeavor to show the *why*

as distinct from the *how*. It is not necessary to cut it to keep it; and there are some reasons why it should not be done.

Prudential considerations. -- The cost of cutting machinery is considerable; the work of filling the silo, when once the work is begun, must continue without intermission, except, say for a day; a large number of men are required to handle the fodder, and tramp the mass in the pit to keep it from heating too much, and rotting before the crop is fairly housed; and in many places power and labor may not be obtained. In regard to heating: this cannot be lightly considered or underrated. In cutting the fodder — I now speak of corn — into such small pieces, in the mashing to which much of it must be subjected the chances of rapid oxidation are increased many fold; for the points of contact with the air are a thousand times more than when the stalk is exposed to the air at the bottom only, where it was cut from the stump.

Another thing in regard to this heating: it is a true oxidation of the more easily destructible compounds, and does not resemble the changes taking place from catalysis: for, in the cutting and mashing, the silicious envelop — the air-tight and water-tight covering nature provided to keep destruction at bay — has been entirely destroyed; and changes that might have taken place at the expiration of weeks, possibly, have taken place at the earliest possible period.

We know that green corn-fodder can be left loosely in mass, uncut, for a length of time sufficient to deliver to acetous fermentation and utter destruction the same amount of fodder cut into inch pieces.

So far as the actual merits of this method of applying the silo system are in question, I am not convinced that it is the best.

But there is a side to this question of altogether a different range. We have in Massachusetts, everywhere in fact, one and two man farms. If these farms are to have any benefit of the silo system, there must be one and two man silos. If money were not wanting to build expensive pits, and purchase the cutting-machinery, the *labor* is wanting. We cannot make the farm to fit the silo: therefore we must make the silo to fit the farm. Can this be done? It can.

The only point to be considered in preserving the fodder is this, — weight on the top to expel the air, and to prevent the access of more. The air and water tight sides and bottom of the pit have nothing whatever to do with it: they are only the *form;* the weight is the *substance.* It is not necessary to cut the fodder into small pieces when it is massed. To secure close packing, it is only necessary to lay the fodder all one way; so that, when heating takes place from agencies at work *within* the stalk (which has been opened at the bottom only), and the envelop softens, the weight applied at the top will compact the stalks firmly together.

Common prudence would dictate such a manner of laying the stalks; for, by laying them in all directions, room is wasted, and spaces to retain air and gasses are created.

To secure a uniform settling of the mass, have the retaining-walls of the pit (no matter of what they are made) plumb, or, better still, inclining inward at the top one inch to six feet rise. To render the operation of filling the enclosure more easy, dig a short distance into the ground, more or less, according to the amount of fodder to be stored, and the location. The posts will thus be more easily kept plumb, and the dirt excavated is just where it is wanted, — to bank the sides, to keep them in position, and protect the mass from the frost. When these simple precautions have been taken, the pile may be made and tramped as well as two men can tramp it; and, if necessity requires, it may be left for a week, provided a small weight be placed atop.

If a week should intervene between the time of leaving one lot of fodder and beginning to put in another, no harm is done; for when the heating takes place, and the stalk softens, the mass will settle enough to exclude the air between the stalks, and the heating nearly ceases. When the whole mass is together, it may be covered with straw or old hay, and weight applied. If stone be used, half a ton to the square yard is the rule; if dirt, two feet is none too much.

This method of applying the silo system has some disadvantages, as well as the other. If the pit is in the field, distant from the barn — it is often bad weather when the farmer wishes to remove the ensilage, — working in the wet

and cold is disagreeable. The ensilage must be cut down with a hay-knife, and carried to the place of feeding in quantities larger than one is obliged to remove from a pit when the fodder is cut small.

It is, however, cheap. For ten dollars, material enough can be obtained to enclose a space of two thousand to three thousand cubic feet, — enough to contain thirty to fifty tons of fodder.

If a silo of this kind be desired for a permanent thing, it can be built of stone near the barn, — the side laid rough, like a wall, but with straight and plumb lines, — and the lining can be put in yearly. No bottom but the ground is necessary. If such a place be made, it could be located, as are many of the barns, on a side-hill, and one end left open; in which case it would be available for many purposes during those parts of the year when not used for its primary purpose. Covered with a roof, and with a covered way communicating with the barn, it might be as handy as one made in cement, and filled with cut fodder.

In this way a pit can be made which calls for no labor or material other than that provided by the farm itself.

As I have described it, any farmer can make use of the silo. I think the chemical processes have been explained in so mechanical a manner, that further explanation is not needed. The result of the fourth experiment you see before you.

QUESTION. Does the ensilage taint the milk?

Dr. FAXON. I have got, I think, a set of customers that will growl at a suspicion of taint in their milk. I have a few men who take four or five quarts of milk a day. They are pretty tolerably well off; and they want the best things in the market, although they grumble a little when I raise the price. They tell me that my milk is better now than it has been all summer, and they want to know what makes it so.

QUESTION. Do your cattle eat it all up?

Dr. FAXON. Here is the man who feeds it out. He will tell you whether they eat it up clean, or not. I do not see it very often.

Mr. WINSHIP. Yes, sir: they eat it all up.

[Dr. Faxon exhibited some specimens of his ensilage, which were critically examined, and commented upon by many of the audience.]

Mr. Hersey. I have given this subject of ensilage a good deal of attention by way of investigation, not by practice. I have no silo of my own. I did intend to build one, and therefore I endeavored to ascertain all that I possibly could in regard to the system; but, so far as I have gone, I have not felt, that, with my limited means, I could yet afford to try the experiment of building an expensive silo. I have listened to the paper which has just been read with a great deal of interest, and there is much in it with which I can agree. The profits which are to come from building a silo I think, as yet, are doubtful. The farmers of Massachusetts generally do not keep more than three or four cows, and therefore they do not want large quantities of this green fodder. If they build an expensive silo (and if they build a good one it will be expensive), they will certainly be out at least fifty dollars a year for interest on the cost of the silo, and repairs. You can all of you readily see how much a silo would do towards keeping three or four cows. Therefore it seems to me, that at present we are not sufficiently well-informed in regard to this matter, to go into it very largely; but I hope that those who have silos, and those who have ample means to build more for experimental purposes, will go on, and that they will give to the farmers of Massachusetts that exact knowledge which is necessary for them to work, and work successfully. You can all of you see that this ensilage is not perfect; and, as I understand, it cannot be kept without losing a portion of its sugar, unless it is kept very nearly air-tight. Now the question comes up, Can farmers afford to lose the sugar out of their corn-stalks? That is an important question, and one which will be finally settled by accurate experiments. In order to test this, I say that now, more than ever, we want an experiment station established by the State. If we had an experiment station, how easy it would be for them to test this matter, and to give to the farmers of Massachusetts the result, and thus save them from making, each one, the experiment for himself! Were I to give any advice to the farmers of Massachusetts, I should to-day give the same ad-

vice that I gave last winter; and that is, Wait a little longer, those of you who would have to hire money to build silos — wait until the matter is better understood, until we may know and feel a more positive certainty that it is a good investment. Farmers work hard for their money; and therefore I do not think that it is good policy for them to put it out in any very expensive experiments. And yet I am in favor of experiments. I believe that it is the duty of every farmer to try more or less experiments which are not expensive every year. There are many which he can try on his farm, the results of which will be beneficial to him. But here is an experiment which is expensive. It cannot be otherwise than expensive, to build a silo of rocks and cement. If the experiment can be tried in a cheap way, as has been stated here, it would not be open to the objection which I raise against an expensive silo.

Mr. CHEEVER. We have a gentleman here who is a practical farmer, who has built a silo (one of the first in the State), who, I believe, thinks that he has converted me. I have been almost converted. He works every day on his farm; and I want him to make a few practical remarks. I refer to Mr. Thompson of Hopkinton.

Mr. TAFT. I want to say that Mr. Thompson has a farm, that, when he took it, would not grow a mullein-stalk.

Mr. THOMPSON. I had thought about preserving fodder for several years. My son wanted to go into it some time ago; but I told him we did not know any thing about it, and we would wait and see. I went and looked at a silo, told my son how it was made, and he said he would build one: he knew he could do it; somebody else had done it, and he knew he could. We went at it a year ago last July, after we got done haying. We were about six weeks in finishing it. It cost us about three hundred dollars; perhaps a little over, reckoning every thing. It is thirty feet long, twelve feet wide, and thirteen feet deep, and will hold one hundred tons. It is built with concrete, sand, granite, and cobble-stones. The first of September we put in some forty-five or fifty tons of fodder-corn, — what we grew on two and a half acres. About the 25th of November we opened it, and commenced feeding it. We make milk for the Boston market. We could see a marked difference in the quantity of milk the next week

after we commenced feeding it. After we had fed it a short time, we took the cows off of the ensilage, and put them on dry feed, and they soon went back. Then we changed back to ensilage again, and the yield of milk increased as before. We fed it through the winter to eight or ten milch cows, until the 12th of May, when it was all gone. We were then getting ten cans of milk a day. We put them on hay that was cut on the 17th of June, as good hay as ever grew. In three days they went down to eight cans a day. We could not get them up on any thing we gave them after that.

This year we have put in about sixty-five tons. We commenced feeding the ensilage some three weeks ago, and are feeding now about seventeen or eighteen head. We feed about fifty pounds of ensilage to our milch cows, and some three or four pounds of dry feed, six or seven pounds of grain, or three quarts of cotton-seed meal, a day — no hay.

QUESTION. What was the expense of putting it in?

Mr. THOMPSON. About a dollar a ton to cut it, take it from the field, put it in, and cover it up; and it cost us about a dollar and a half a ton to raise it. What we put in this year was grown on about four acres. Our corn did not come up very well, and it is well known that corn did not grow well this year: the crop was not more than two-thirds what it was last year on the same ground.

Mr. HERSEY. You say it costs a dollar and a half a ton to raise it. Can you raise an acre of corn-fodder for twenty-two dollars and a half?

Mr. THOMPSON. On my land the work is a very small part: all the hand-work is dropping the corn. If I had a machine, I could do it for a little less.

Mr. HERSEY. How much manure does it take to raise fifteen tons of corn-fodder?

Mr. THOMPSON. It will take about three cords of what I should use; that is, clear manure.

QUESTION. At what stage of the growth of the corn did you cut it?

Mr. THOMPSON. I cut it when some of the ears were very nearly large enough to boil.

QUESTION. What kind of corn?

Mr. THOMPSON. I planted Southern white corn.

QUESTION. What was the condition of the cows in the spring?

Mr. THOMPSON. I can tell you of one in particular that has been a winter cow for some six years. All who saw her last spring said she was a hundred pounds heavier than they ever saw her before in the spring of the year. I do not know how that was; but, at any rate, my cows looked better than they did other years.

Mr. HADWEN. How many acres have you that you cultivate?

Mr. THOMPSON. There are about thirty acres, pasture and all. We have now twenty-one head of horned cattle, and two horses.

Mr. HADWEN. Have you ensilage and hay enough to carry them through?

Mr. THOMPSON. Yes, sir, I have.

Mr. TAFT. You cut but very little hay?

Mr. THOMPSON. I cut, perhaps, six or seven tons of good hay.

Mr. CHEEVER. Will you tell how many acres you have of tillable land, aside from the pasture?

Mr. THOMPSON. There are about five acres of river-meadow, we call it bog-meadow, land.

Mr. CHEEVER. About how much tillable land? — that is the point.

Mr. THOMPSON. There are about eight or nine acres of pasture; and the rest is tillage-land, — about sixteen acres of tillage.

QUESTION. Don't you feed any grain to your cows?

Mr. THOMPSON. If I am feeding cows, I put in meal, and sometimes a little shorts. My stalks are cut three-eighths of an inch long, and well trodden down.

QUESTION. Any injury to the cows from feeding three quarts of cotton-seed meal a day?

Mr. THOMPSON. No, sir.

QUESTION. Does it not affect the bags?

Mr. THOMPSON. No, sir. I feed it in two feeds.

QUESTION. Do you raise your own cows, or buy them?

Mr. THOMPSON. I raise some, and buy some. Sometimes I keep a cow one season, and sometimes two, three, six, or eight, just as it happens. If I get good ones, I keep them six or eight years.

QUESTION. You do not find that the cotton-seed meal

does any damage to those cows that you have kept for several years?

Mr. THOMPSON. No, sir.

QUESTION. Would you advise farmers with small means to borrow money to put into a silo?

Mr. THOMPSON. That is just the class of men for whom the silo is adapted. A man who has plenty of money of course can do as he has a mind to; but the man who has but little must economize. As far as my experience goes, two or two tons and a half of ensilage will make as much milk as a ton of the best hay that I can get.

QUESTION. You said your silo cost you about three hundred dollars: does that include your own work?

Mr. THOMPSON. Yes, sir. We had to hire a good part of the job done. We had to hire all the stone drawn, and all the cement drawn. We counted every hour's work we put into it.

QUESTION. How many times a day do you feed your cows?

Mr. THOMPSON. Only twice, — ensilage, dry fodder, and grain at the same time.

Mr. HADWEN. Do you consider the quality of your milk as good as it used to be?

Mr. THOMPSON. I will tell you a little circumstance, and you can judge for yourself. My milk goes to Boston. Last September, a year ago, the man who buys my milk found out that I had built a silo, and got my corn in. He had had my milk for a good many years. He came to see me, and said, "You can't make milk out of that stuff: it isn't fit to make milk of." I said, "I have got it in there; my cows are eating it; and, if you don't want my milk the first of October, just say so, and I will do something else with it." I waited some four weeks before I heard a word; and then one of the firm came down there, and looked at the milk, and said it was all right. I saw Mr. Royal last March, and asked him how the milk was. He said he had kept a pretty good watch of it, and it was all right. I had a chance to sell my milk outside, and he would not hear a word about my letting it go. He said, "I want your milk, and you must not let it go."

The CHAIRMAN. I would like to ask Mr. Cheever if this experiment has convinced him.

Mr. Cheever. I will answer that by asking another question, — the same question that was asked me this afternoon. My impression is, from what I have heard Mr. Thompson say — I have never put it to him directly, and do not know as he can give a direct answer — my impression is, that, having been in the milk business for twenty years, perhaps (a good many years, certainly), having had the same trouble that all others have had of low prices for milk, and feeling uncertain whether it were best to give up the business or not — my impression is, that he feels stronger now in the milk business than any time before within ten years; that he is satisfied, from his books, that his farm is bringing him more money for the labor and capital expended in the milk business than it has done before. Is that impression correct, Mr. Thompson?

Mr. Thompson. Very nearly, sir.

Mr. Cheever. Then, if Mr. Thompson can introduce a silo, and go right on in the same business, and make a number of dollars more on his balance-sheet at the end of the year than ever before, why does not that answer the question?

Mr. Taft. It seems to me that the audience ought to understand a little about the condition of Mr. Thompson. He is not on a farm like those that we see here in Norfolk County or up in Franklin County. I presume that on Mr. Thompson's farm, when he took it, there was not an acre from which he could get five hundred pounds of English hay. It was utterly useless for a man to think of pasturing cattle on the land that Mr. Thompson had.

Mr. Thompson. I will say this: twenty years ago, all the hay that grew on the land I cultivate now one horse could have drawn anywhere.

Mr. Taft. There is no question about that. I much wondered, when he started, that he had the pluck to do it. I know, of my own personal knowledge, that he has got a good living there, and is making money. Whether you want silos on your fine farms may be a question; but I am satisfied of this, — that, if you are going to make milk on such land as Mr. Thompson has, you cannot do it by pasturing; you cannot do it by raising crops, as our friend Mr. Cheever would: you have got to raise your crop before the drought

comes, and put it where you can take care of it. I have no question that Mr. Thompson has made a success with ensilage. There is one thing very certain, — that, when he spends a dollar, he does not lose a tenth or a mill on what he puts out, because he earns his money by hard work; and, gentlemen, if you understand this, you will appreciate it.

Mr. WARE (of Marblehead). I was not present when the essay was read before you; but, as near as I can judge, you want experience, you want facts. I will tell you my experience in a very few words, without any theory whatever.

I was convinced years ago that we in New England, if we would succeed in farming, must make a change; and, on looking about, I felt that the change was indicated in the building of silos, and the use of ensilage: therefore this year I have built a silo, and have put in about one hundred tons of ensilage, — the product of four acres of fodder-corn and three acres of heavy rowen, mixed, and put in together. I have built a good silo on the most approved principles, and filled it according to the best directions that I could get, and I am now feeding out the ensilage; and what you want to know, I suppose, is the result of the feeding.

Mr. TAFT. What did your silo cost?

Mr. WARE. The silo cost about five hundred dollars to build: the machinery necessary to run it completely and practically cost about four hundred dollars more, I should say. I have not figured it exactly; but in round numbers, say, I have invested about nine hundred dollars.

The question has arisen here, whether farmers can afford to build silos. I have never heard the question asked, whether farmers can afford to build barns to put hay in, or whether they can afford to build root-cellars to put their vegetables in to feed to their cattle. Now, the question comes, Can they afford to build silos to put ensilage to feed to their cows? In answer to that, I will say that it takes the product of two acres of grass to winter one cow. If we can winter six cows on the product of a single acre, it seems to me that question is answered; and that is the result of my observation and experience. I am now feeding my herd of ten cows, four calves three months old, six horses, and a dozen or more of swine, substantially on ensilage. The cows are having nothing else, except that those that give

milk have two quarts of cotton-seed meal. Some of my horses have ensilage only, some of them have a little hay with it, and they are thriving nicely. I had supposed that this food would have a bad effect, making animals scour; but there is no trouble of that sort. My horses are thrifty and brisk. My cows have been milked all summer. I want summer milk, not winter milk. I took them in from good fall feed — I allow my cows to run over my fields, where there is first-rate feed, until it freezes — I took them from that field, and put them on ensilage, with the addition of two quarts of cotton-seed meal, and they have increased their milk considerably; so that I feel it is no longer an experiment, but it is a complete success with me. I felt that it was no longer an experiment before I tried it myself, because I had heard the experience of many others, and I was satisfied that I could depend upon that experience. We have in our county a man who fed his stock of milch cows on ensilage all last winter. I went to see them in the spring, and they were looking finely. I saw a small cow, not much bigger than a goat, filling an eight-quart can at a milking, and fed on ensilage alone.

Now, we are told that a great loss takes place in this fodder by the process of fermentation. Allow that there is: if, with that loss, the result of feeding it is better; if the result shows an increase of product, either in milk or flesh, — what care we, brother-farmers, how much percentage there is lost, according to any calculation that has been made? It is *results* that we want.

The question has been asked, Can farmers afford to borrow money to build a silo? I tell you, my friends, that last year I paid three hundred and odd dollars for hay; and I felt that I could not afford to do that. I built a silo, and run the risk; and my barn is filled with hay, and there it lies. I am feeding my cattle with ensilage, and saving my hay for another purpose, to be used next summer. I shall not have to pay a dollar for hay: I think I shall have some to sell.

The question settles down to this: Is it better to winter six cows on the product of one acre, or to keep one cow through the winter on the product of two acres? It does not require very much arithmetic to cipher that out, and that settles the whole question. That is the result of my

experience; it is the result of the experience of others in Essex County whom I could name; and I have no question about it.

Now, one word with regard to the question whether the milk tastes or smells of the ensilage. Mr. Walcott of Peabody, who was the gentleman to whom I alluded, supplies milk in Salem. A lady customer sent word to him that she could not take his milk, for it tasted so of ensilage she could not endure it. "Very well, madam," he said, "I will supply you with something else." He had been supplying her with milk that he bought from a neighbor, that was not made from ensilage. He supplied her afterwards with milk made from his own cows, that were fed on ensilage, and the lady said that was all right. I have been very careful, for I had heard the story that the milk tasted and smelled of ensilage. If that was so, it would be a serious objection; but really I have never tasted sweeter milk than I am getting from my cows at this time. I have invited guests who have come to the house to taste it carefully, and see if they could detect any bad taste or any bad smell in it; and they have all pronounced it to be excellent.

Mr. Taft. Do you consider corn-fodder the best fodder to grow on first-class land to put into your silo?

Mr. Ware. So far as my observation goes, I do, for this reason: I think there is no difficulty in raising forty tons to the acre. Before I tried it, I thought I could raise fifty tons. I still think I can; but I think there is no difficulty in growing forty tons, so that we get a very large quantity to the acre, and, by allowing the ears to mature to the point when the largest ears are fit for boiling, there is a great deal of the grain principle in the crop. I planted the rows three feet and nine inches apart with a corn-planter, calculating to leave a stalk every once in nine inches. It did not come up very well (it was a bad season this year); so that it was not nearly so thick as I expected, and I did not get so large a crop as I should have done if it had come up better. I got over thirty tons to the acre; but, if it had come up fairly, I should have had forty tons. I found that where it came up a stalk once in nine inches the stalks grew quite large, and were as well developed as where they had more space; but I should recommend planting the rows three feet and a

half or nine inches apart, and having a stalk as near as may be once in nine inches. Some of those stalks weighed nine pounds apiece.

Mr. Taft. I asked that question, because I was at a silo in Saxonville, on Mr. Micah Sampson's farm, and in the barn he had thirty-three oxen; and the man who ran the place told me he put them in in November, weighing twenty-three or twenty-four hundred to the yoke by actual weight. He kept them in the barn thirteen weeks. They were then sold, and were going the next day to Boston; and he estimated the weight of the oxen — and I think he was not a great ways out — at thirty-eight hundred to the yoke. They were fed on ensilage, and all the corn-meal they would eat. I then asked Mr. Neal, who had charge of it, what was the best material to put in the silo. He said, "The best quality of English hay, just as it is heading out." How much hay he would grow to the acre, I do not know. Of course, there is land that will grow ninety or a hundred bushels of corn to the acre, manured as they manure first-class land on Concord River.

Mr. Ware. I will mention that I put in three acres of heavy rowen that was just heading out.

Mr. Taft. What would that weigh to the acre?

Mr. Ware. It would cure probably two tons to the acre when it was green: I don't know how much it would weigh; but I had a very heavy growth, and I mixed it with the corn. My cows eat it all up clean: there is no waste. The three calves are eating ensilage, and they are thriving: they look remarkably well. The pigs are rather young, and I do not feed them on that alone: they have about half of that at the present time. Part of my horses will eat it all up: the other three have not yet arrived at the point where they will eat it as they do hay.

Question. How do you cut your rowen?

Mr. Ware. I cut that a little longer than the corn. I cut the corn three-eighths of an inch long, or as near that as may be. I alter the machine to cut the rowen, and cut it an inch and a half long.

Question. What kind of corn do you raise?

Mr. Ware. It was Blunt's prolific. I think that is better corn than Southern dent corn, because it inclines to

more size. I had one acre of Southern dent corn, and two acres or a little more of Blunt's prolific.

Mr. Russell. You say you feed horses on ensilage: can you state how much ensilage you feed to a horse?

Mr. Ware. I feed them forty pounds a day; and those that eat forty pounds a day have a small quantity of hay and grain.

Mr. Russell. What do you mean by a "small quantity of hay"? About how much?

Mr. Ware. I should say five pounds, perhaps.

Mr. Russell. How much grain do you feed each horse?

Mr. Ware. I should say two quarts to a meal. And allow me to say that those horses are not race-horses: they are horses I use on my farm. I drive them moderately, but they prick up their ears very nicely since I have given them ensilage. I have a light carriage; and I have felt some little fear, as I belong to the Essex County Agricultural Society, that I might be called to account for driving fast horses.

Mr. Russell. If I fed a horse forty pounds of any nutritious food, five pounds of hay, and six quarts of grain, I should do it solely for the purpose of getting manure.

Mr. Ware. You understand that this ensilage is supposed to contain about seventy or eighty per cent of water?

Mr. Russell. I should say it was entirely useless for nutrition, if a horse could get away with that amount, five pounds of hay, and with two quarts of meal at a feeding. Are your horses at work?

Mr. Ware. Not hard, but steady work.

Mr. Russell. For a horse not at hard work, I call four or five quarts of oats and eight pounds of hay a full ration.

Question. How much water does a horse drink in the course of a day?

Mr. Russell. Horses vary. Horses are like men, — some of them are thirstier than others.

Mr. ——. I asked that question because the ensilage that horses eat contains all the water they want.

Mr. Russell. I am sure that Mr. Ware does not have any trouble about watering his horses. If he gets forty pounds of any sort of food into them, besides that hay and grain, I think he is wasting his ensilage.

Mr. Ware. I said five pounds of hay. I do not know how many pounds, but a very small quantity.

Mr. Hadwen. I only rise to put in a little evidence in this case, not growing out of my own experience, but from my observation and reading, and my talks with gentlemen who have tried the silos.

It was my good fortune to meet, in September, a gentleman, who, I might say, stands in the front rank in the silo business; that is, Mr. Mills of New Jersey. He has had six years' experience, and his accounts almost staggered me. I had been on the fence in relation to the silo question, gathering what information I could from all sources; and I have to confess that the preponderance of evidence is in favor of the silo. Mr. Mills informed me that in the year 1880 he fed the product of thirteen acres of land to one hundred and twenty cattle (one hundred being milch cows, and twelve horses) for a period of seven months. I questioned him further in relation to his milk, which he sent to the New-York market. He informed me that the quality of his milk was improved, and that he obtained a greater price for his milk than was paid for any other milk which went into that market. He now has six silos, and I questioned him somewhat in relation to the construction of these silos. He informed me that a great deal more expense had been put into the silo than was necessary. He said, as Dr. Faxon told us, that the great object was to get pressure upon the top to press out the air from the fodder. He said, furthermore, that a silo should be filled in two days; that, if it could not be filled in two days, a partition should be made in it, and a portion filled; but the work should be completed in two days, and the pressure applied immediately. He applied the pressure in sections. His silos are forty feet long, thirteen feet wide, and twenty feet deep. The fodder is piled fifteen feet high above the silo, so that when it is pressed down the silo will be even full. He informed me that he put on this pressure in sections of plank, each four feet in width; and, when he used the ensilage, he removed the plank, and cut down perpendicularly one section of four feet. He also stated that he weighted these planks with grain: five tons of grain in bags was put on each section of four feet; and when the grain was removed it was ground, and fed with the ensilage. I stated to him my mode of feeding cows, that I had practised for a good many years, and he replied to me

at once, that I was an extravagant man, and could not afford to do any such thing; and in hearing the testimony here this afternoon, coming from men like Mr. Thompson, and my friend Mr. Ware — every word of whose statements I can believe in relation to this matter (and I feel also that I must believe every word that Mr. Mills has said, for he appears to be a gentleman of veracity, and certainly he is a very large breeder, — undoubtedly the largest in this country) — in this testimony, we have very strong evidence that a progressive farmer has got to look into the silo question in a candid way. I am rather confirmed in my belief that a silo would be more beneficial where the soil is sandy than where it is a stiff clay, such as we have in some sections of the State. We all know that corn is more easily grown on sandy soils than it is on heavier soils.

There is one other point, and then I stop. Mr. Mills informed me that he had rather come to the conclusion that ten tons of good grass cut at the proper time was of equal value with forty tons of corn ensilaged. That is all I have to say.

The Chairman. I should like to ask Mr. Ware if he can tell us how much the hundred tons of fodder that he puts into his silo weighs when it is taken out.

Mr. Ware. I cannot. I did not say I was feeding my cows sixty pounds a day exactly. I do not know how much loss there is; but I cannot conceive what becomes of the loss, for my silo, except on top, is water-tight and air-tight, and this corn-fodder is put in perfectly green. The men are cutting it in the field, the teams are hauling it, and other men are cutting it with machinery to drop it into the silo at the same time. It is put in perfectly green, and there is no escape for any thing, except by evaporation at the top, that I can conceive of, and that must be very slight.

The Chairman. Shall you know, when you have fed it out, whether you have fed out one hundred tons, or what you have fed out?

Mr. Ware. I don't know that I can tell.

Question. Can you tell to what density you press it?

Mr. Ware. Sixty pounds to the cubic foot. I did not weigh it in: I simply estimated as to the weight of the crop.

Question. How do you consider it compares with corn taken right from the field, and fed, in value?

Mr. WARE. I have fed corn-fodder a great many years green from the field. I have never fed corn-fodder so mature as this that I have put in the silo, and I have never kept my cows entirely on corn-fodder; but as a matter of opinion, without any exact knowledge, I think that the corn that I put in as ensilage is of more value as feeding-material than what I have been in the habit of feeding in its earlier stages. My cows are doing remarkably well on ensilage alone. They always did well before on green corn-fodder, with the addition of some other food. I never fed it entirely alone. Simply as a matter of judgment, I think they never did better than they are doing now on the ensilage.

Recess until half-past seven P.M.

EVENING SESSION.

The meeting was called to order at half-past seven o'clock by Dr. WAKEFIELD, who introduced as the lecturer Hon. PAUL A. CHADBOURNE, ex-president of Williams College.

THE FARMER'S HOME OF THE PAST AND FUTURE.

BY HON. PAUL A. CHADBOURNE.

It is useless to try to escape work in this world, unless we are willing to neglect duty, and shut ourselves out from those men who are blessing the world by increasing its products, its knowledge, and its goodness. Four years ago I insisted upon resigning my place on the Massachusetts Board of Agriculture, because I could not find time to do my duty. It was true, I had worked years for nothing, and on that account might, perhaps, have claimed freedom from work, while reaping the honor of the place; but holding that a man is to do what he undertakes to do as well as he can, whether paid for the work or not, I resigned, and gave my place to abler hands with more leisure for the duties of the Board. But here I am to-night in my old place, by invitation of the honorable secretary; and I accepted his invitation because I have one thing more, at least, that I wished to say to the farmers of our State on one subject which I wished to present to them for their future consideration.

We meet in this Board in our home societies to discuss the progress in agriculture, and to devise means for greater progress in time to come. We raise every farm-product in greater quantity and in greater perfection than we did fifty years ago. But how is it about the men and women on the farm, the children on the farm? Are we doing so much better for them, that they shall love the farm, and that farm-life shall be in reality what it ought to be, what it may be, — the most satisfactory life of our people?

In order to emphasize this question, you will please bear with me while I give a sketch of farm-life in New England, mark something of its progress, point out what seems to me to be some of its defects, and some of the means by which it may reach its true place in the aggregate life of nature.

I am satisfied that there has been great improvement in farm-life within forty years since the time that I left the farm. I have this fall returned to the place of my boyhood, and have spent the last three months on the farm that has been in the family over a hundred years, — a farm that I bought, not because I was able to properly care for it, but because it belonged to my ancestors, and held two generations of them beneath its green turf. Here I was surrounded by the farms that I knew well when a boy, — farms still in the old family name, though the fathers are gone, and the sons, who were my schoolmates, rule in their places. It is easy, then, for me to see the improvement, not in a single place, but all along the line; not simply the improvement in cultivation of the soil, but in general methods of living. I cannot mark the change better than by describing some of the conditions of farm-life as long ago as I can remember, by rehearsing some of the maxims that then prevailed among farmers, — maxims that they thought came from Dr. Franklin; but, if he was the author of them in the crude, harsh form in which they were applied to farmers' boys, he deserved to be struck hard with that lightning he used to bottle up.

In the first place, on the average farm of Maine forty years ago they had not discovered dry wood. If they had dry wood at all, it was simply for kindling the fire, — the dead limbs of some old tree, or bits of broken boards; but to burn in the body of the fire regular, seasoned body-wood would have driven some of the old farmers into frenzy. They

jogged off into the woods, cut down some birch, and perhaps an oak, picked up some old soggy log, and perchance found something better in some dead tree standing. This was hauled home, and piled up in the dooryard, and perchance, the next morning, had disappeared under a layer of snow, from which the wood was dragged as it was wanted, cut, and carried into the house after they had pounded off all the snow that would pound off easily. The rest could be thawed off, if the wood for the night was piled near the fire. At other places, where there was perhaps less thrift, a single tree would be cut down, and "twitched up," as they called it, limbs and all; and this gradually disappeared: then another took its place. The most thrifty farmers did make it a point to get up wood in winter — generally the limbs of the cord-wood they hauled to market — for summer use; so that the good-wives had dry wood, if ever, in hot summer-time. But fortunate were those whose yards were not bare of wood before haying was done, which in those days was late in August, if not in September. I remember also, at the schoolhouse, or schoolhouses (for I attended school in several districts, to make the money go farther), each farmer furnished his proportion of wood; and I can see them now, as they came with loads of green logs, and piled them up before the schoolhouse door. Then the boy or young man whose turn it was to build the fire next morning was excused to cut and split logs for the next day's fire, and then, on a cold winter's morning, started before sunrise from his home, with an armful of kindlings, to build a fire in the big fireplace of the old schoolhouse. If the lot fell upon a bungler, or worthless fellow, then the big fireplace was surrounded with shivering urchins and tearful girls suffering from the cold. The only redeeming feature to all this was, that they made the fireplaces so large in kitchen and schoolhouse, that, if the fire once begun to burn in the huge pile of green wood, it made a heat that dried the wood, and warmed all around it, and left a cheerful remembrance of comfort, in contrast to the discomforts, that remains to this day, and throws around the old fireplace a halo of glory that scarcely belongs to it.

In the second place, the farmers of that day, living where pure air and pure water were plenty, ready-made to their hands, too often managed to poison both of them, and sow

in themselves and children the seeds of disease, if they did not reap sudden early death.

The old-fashioned living-room of the farmhouse, used for cooking and eating by day, and as a sitting-room in the evening, was well ventilated so long as the old fire held its place on the hearth; but most of the sleeping-rooms were "bed-rooms," so called, just large enough to hold a bed, with standing-room to get into it; and in such rooms two persons breathed the air over and over again through the long winter nights. In the summer they were driven to ventilate; but in winter the air, though cold, was unfit for human beings to live in. While the houses generally were so ill-heated as to be cheerless, they were so poorly ventilated as to lower vitality, and lay the foundation for consumption and other kindred diseases. There was also in the cellar all the vegetables from the farm; and in spring-time many of them were left to decay, and contaminate the air of the house, the foul air making its way readily through the defective floors.

Then the well was dug in the most convenient place, without any proper regard to the drainage on the farm. If the water remained clear and tasteless, it was considered pure, as a matter of course. So fevers were abundant; and some families were said to have a predisposition to fever, which, in most cases, meant that the sanitary condition of their homes, the impure air and water, brought fever to some member of the family almost every year.

Then, look at the products of the farm, and the labor required for its cultivation. The raising of stock of all kinds was a haphazard matter, — "native stock," we called it. The animal raised was spared simply because it had some peculiar color or point of form to recommend it; but no one could tell what would be the result. The promising-looking heifer might make a cow that would give half a mess of milk, or milk so blue that cream was either an unknown quantity, or a steam-engine was needed to get any butter out of it. I wonder if some farmer before me does not have a grudge against those old cows that furnished cream, that had to be punished all the long winter evening to yield butter, and then often yielded nothing but froth. No wonder the old New-England housekeepers so often thought their churns bewitched.

As a sample of fruit-raising also, take the old-fashioned orchard. I can remember two large orchards on my own farm; and a few of the old trees still remain as reminders of the generations that are gone. Not one tree in ten yielded fruit that could be eaten with comfort. They were all seedlings. No one knew when they were set, what they would bear, except that they would bear apples. There was not a grafted apple-tree on the place. Here and there a tree produced apples that could be gathered for family use; but nine-tenths of them were sour, bitter crabs, that would indeed yield cider to curse its maker. I think the cellar I now own has many a year had more than fifty barrels stored in it; and I have never heard that any of it did any good, except the small part that changed to vinegar. Some of it was sold for money, it was true; but it was poor stuff to sell, in any point of view.

The meat of the farm was salt-pork and salt-beef. Cabbage was about the only vegetable that figured largely in the farmer's bill of fare. Pork and potatoes were the basis of the winter living. Fortunately for the children, milk was a cheap article, generally abundant, and so they had enough of it; and, as all the best part of milk for children remains after it is skimmed, they could not be cheated out of what was really the best thing for them to eat. The cows, even the poor natives I have described, have been the salvation of the farmer's household in giving to the children the life-giving nourishment which ignorance or avarice might otherwise have denied to them.

There were mistaken notions in regard to eating, clothing, sleeping, and working. The farmer's children, in general, were over-worked and under-fed; that is, if you consider the real value of food. They were too much exposed to cold and wet, and too often deprived of the proper amount of sleep. Life was made hard and unpleasant, and injurious to the best development of mind and body, from a mistaken notion that it was a good thing for children to learn to "rough it," — to become tough by hard labor, and exposure to cold and wet.

There were marked exceptions to the picture as I have drawn it, but they were few. Farm-life for those who owned the farms, and for the children raised upon them, was in gen-

eral hard, giving but little real enjoyment and gist to life, and certainly very little culture.

The pleasant things remembered about the old farm are so remembered because it is the habit of the human mind, I am glad to say, to remember the pleasant things of life; and few places can be so hard that we shall not have for them some attachment. It is said that old sailors grieve to leave their miserable quarters in the forecastle of the old ship in which they have long sailed; and Dickens brings out this same trait of human nature when he represents Oliver Twist as crying when he left the miserable place where he had spent a squalid babyhood as a parochial pauper. Meeting one of my old boyhood friends this fall, and referring to the old modes of life among our fathers, he replied, "It was a mere struggle for existence." I replied, "Yes, but a much harder struggle than there was any need of." My friend owns the same acres where his father lived. The soil is by nature no better; the same skies are over him: but he lives a very different life from what his father lived. On the same old farm he can have around him, and does have around him, the luxuries of life even, which give to farm-life an entirely different status for a man of thought and heart from what it had when he was a boy. The same change in kind, though not always in the same degree, I notice on all the old farms. The sons, as a whole, have advanced upon their fathers in the art of living. The physical, intellectual, moral, and social life are better cared for than either was at that time. Houses are better, and better furnished. The farmers and their wives do less exhausting labor than they did in those old times. Their food is better; their houses are better supplied with papers and books; their help is better paid. Where the Yankee girl fifty years ago worked for fifty cents a week, or a pound of wool, she wants and gets two or three dollars a week, or six pounds of wool. (She takes her wool, however, now, only in the form of cloth, such as no farm-born Yankee girl fifty years ago ever thought of wearing.) The farm-hand who used to work for fifty cents a day, or half a bushel of corn, now wants and gets his dollar or dollar and a half; and a bushel of corn would not satisfy him. So wages have advanced for farm-laborers much more than the cost of living. This shows that farming pays all better than it did.

Then the cellar is not now so often filled with cider, to brutalize old soakers, and lay the foundation of intemperance in the farmer's son. The haying can now be done without New-England rum in the field, with all its attendant evils. The schools are better, and the churches better built and cared for, except in those hill-towns where the number of inhabitants has greatly diminished. Some of these places have still to contend against great disadvantages, so much of the spirit of fifty years ago still dwells in some of them. I do not now speak of those isolated examples, but of the general movement all along the line of New-England farm-life.

But the movement has not been so rapid or so general as it should have been; and therefore I wish to throw out the suggestions that have occurred to me in observing what has been done, and what still remains undone. I see, or think I see, great possibilities in the farmer's life yet to be reached.

Agriculture is now, and must from the nature of the case ever remain, the employment of the great mass of people in the world. Men cannot live on the products of mines and mills. The raw materials of food and clothing, to say the least, must come mainly from some form of agriculture; and, while this is so, agriculture must employ the greatest number of any business in the world.

The Commissioner of Agriculture reports that a majority of the adult males of the United States are engaged in agriculture, and that farms and farm-implements represent fully two-thirds of the productive wealth of the nation. This condition of life, so far as we can see, must, from the necessity of the case, remain essentially as it now is. Since men and women are the final product we wish to reach, and the increase of rational human enjoyment the great end of rational labor, it is of the utmost importance that this great mass of humanity connected with farm-life should be able to secure the least possible conditions for human development and enjoyment.

The *home* is the centre of life; and the farmer's home we wish to improve, — to carry on more rapidly and intelligently that good work that has been going on for the last forty years. It is an exceedingly uncertain thing to prophesy in

regard to the future conditions of human life. Some new element may come in quite out of our line of data, and the problem be solved in a way we never thought it could be. In fact, that which we reckon as sure to take place not only often fails to come, but the exact opposite may appear. As an illustration, I remember when my own town burdened itself with a permanent tax to aid in building a railroad. The argument used with the farmers to secure their votes for the measure was, that railroads must burn a great deal of wood, and so the value of every woodlot on the hillsides would be largely increased. All this seemed to be conclusive; no one thought of doubting such statements: and for a time the railroads bought wood, and the good time for woodlots seemed to be at hand, when, all at once, the railroads began to burn *coal*, so they did not wish to buy wood; and more than this, they began to bring in coal to take the place of wood, so that the woodlots were not worth as much as they were before the railroads came. The taxes on the bonds had to be paid all the same.

When the war abolished slavery, we at the North were glad to see slavery go; but we almost all thought our supremacy as a nation in cotton-raising was gone. The "free negro would not plant cotton," it was said; or, if he planted it, he would be too lazy to gather it at the proper time. Well, we see more cotton raised at the South than ever before. It is picked and baled in better condition than ever before. All the world has to do, is to say how many millions of bales it wants, and the negro that we thought would not raise cotton at all will sell the world all it wants.

Such cases might be multiplied; and therefore, when picturing the farmer's home of the future, we must remember that we live in an age of invention and discovery, and some new element may come in that we at present have no thought of. We must, however, take all the known elements, and do the best we can with them. It seems certain that a very large proportion, probably a majority, of all the people, must continue to be engaged in agriculture. There must be food for all, and such variety of food as will call for a great amount of hand-labor; and there must be material for clothing, — wool and cotton. These come from the field.

The first question, then, that arises, is this: Is the tendency in the future to be to a division of land into small farms, or a swallowing-up of small farms into great estates? Some of the monster-farms have been set up as samples of what is to be; and we have been told, that, as manufactures have grown from the wheel and loom in the farmhouse, so the great farm where machinery can be used on a grand scale is to supersede the little homestead where the wheel and loom once found a home.

As examples of what may now be done, I shall refer to two of these great estates, — one North, and the other South.

The famous Dalrymple farms, or farm, of Dakota. The first has fourteen thousand acres, all under cultivation. The same man manages two other farms; so that he has in all about seventy-five thousand acres of wheat. The territory under cultivation is equal to forty-five square miles; that is, a piece of land one mile wide and forty-five miles long. The amount in highest cultivation is about thirty thousand acres, divided into five-thousand-acre lots. The combined farms yield about six hundred thousand bushels of wheat and seventy-five thousand bushels of oats for the horses and mules. In harvesting, the manager uses a hundred self-binding harvesters and twenty-four steam-threshers. The straw is burned as fast as each pile is cleared of grain. It requires two hundred thousand dollars to pay the bills of the year.

But now mark how much, or rather how little home-life, this enormous production represents. In the spring, men of all nationalities, hailing from no one knows where, apply for work. It is the same all the season through; and, when the work is done, the men go as they came. In the first place, then, we hardly see a trace of quiet home-life in all this vast machinery; and, should that great farm remain indefinitely in one man's hands, there might indeed be a palace for the owner, but there could be no farmers' homes there. There could be nothing but hired laborers' homes, from the very nature of the case, — a kind of tenantry analogous to what we have in Ireland, except that they would receive wages, instead of working land on their own account.

But I think it would be conceded by all, that, in a country like ours, such a farm would be carried on indefinitely only

by the same floating class of laborers that now carry it on; so that such a system of farming, could it prevail, would be antagonistic to home-life.

But we go one step farther, and say, as we now understand the principles of agriculture, such a farm can be carried on with profit in this way only for a limited time. The method is simply land-robbery, or robbery of the soil; and, as the time comes when the soil demands a return, this return must be made from many centres where stock can be kept, and from which farm-fertilizers can be carted; and this can be done at a profit only for a very short distance from the various centres. The sustaining and reclaiming of farms seem to demand that they should be of moderate dimensions, — that seventy-five thousand acres of wheat should represent five hundred large and profitable farms of a hundred and fifty acres each, in a State having diversified labor, as all our States are bound to become. For fifty years to come, that great tract of land will support five hundred farmers' families, and furnish a larger agricultural product of all kinds, for sale, than it possibly could without a family upon it, by the present gigantic system of misnamed agriculture.

Mr. Edward Richardson of Mississippi owns fifty-two thousand acres of land, and raises twelve thousand bales of cotton, being the largest cotton-raiser in the world. He turns every thing to account; and he lives in a place where this system can be carried on longer, probably, than the Dakota system can at the North. But men like Richardson are as rare as Napoleons. Such great estates must fall to pieces, or at least be few in number. The tendency North and South is to small farms, as diversified industry increases, and diversified crops are called for, — those that require an increase of hand-labor.

The old plantations in many places at the South are broken up; and small farmers raise ten, twenty, or thirty bales of cotton, which they gather with care, and turn into ready money. And so I dare to prophesy, however risky this business may be, that the tendency will be towards smaller farms, even at the West and South; that manufactures will spread, and the farms will be called upon for a varied product, which, with its increased demand for hand-

labor, always has a tendency to diminish the amount of land in each farm.

The time is coming, though perhaps a long way off, when the surplus product of our land will come from a multitude of small farms representing pleasant, thrifty homes, instead of from great plantations representing nothing but land-robbery and unsettled wandering wage-labor. And the products of our soil will be more and more consumed in our land, as new branches of manufacturing spring up to supply the materials now purchased abroad.

Believing this to be the inevitable result from the very nature of soil itself, and from human nature, which seeks diversity of employment, we ask ourselves what can be done to make those homes what they ought to be, so that the life in them shall reach its fulness of physical, intellectual, and social enjoyment. And the few words I shall say in answer to this question I shall speak to ourselves, as we certainly are to begin or carry on the work, if we have not already begun it. And one pleasant thing we have to say at the outset is, that all that is needed is for the good work to go on in general in the same line it has been going for the last forty years. We call for no revolution, no change of tactics, but only for that quickened sense of reform which has done much, but has thus far failed to complete its work, and that ready hand to labor, which, when rightly directed, can secure success just as easily as failure.

The first idea we want to see prominent on every farm is, that its chief end is *home*, and that the highest product of the farm — that for which all others are simply conditions — is men and women. We counsel the owners of farms to see that the fruits are the best that can be raised, that the animals are of the best breeds; but we want, above all, that every son shall go forth from the farmhouse with good education, trained to honest labor, with a sense of his duty towards his fellow-men, his country, and his God; and every daughter with equal training, certain then that she will find her own sphere through that womanly instinct implanted in her nature which needs only culture and a fair chance to make her the blessing to the world which all good women are.

To make men and women, we need to secure for them the

conditions of good health, of pleasant, well-directed, useful labor, and the means of intellectual, moral, and social culture. This the farmer must bear in mind in locating for life; and, if the surroundings where he is compelled to locate do not readily give the conditions of all these, he must be prepared to do so much more in the family itself, to supplement the deficiency.

The first thing, then, in the choice of a farmer's home, is that it be in as healthful locality as possible. I refer now to the general character of the region. Then, on the land chosen for a farm, there is often great choice of location as to healthfulness. As a general rule, the buildings should be placed on the highest ground of the farm, if it is readily accessible. It is wonderful what change for the better we can often secure by going a quarter of a mile, and raising one or two hundred feet even. On a hill we may dwell in clear, dry air; while our neighbors half a mile away may spend their autumn and spring nights in fogs and chill. High ground, giving good drainage for buildings, and pure water for the well, is the first thing to be secured. If water can be secured from a spring that comes directly from the deep strata of rocks, so much the better. Never mind the fear of cool breezes on the hill: they will not be half as fatal, at the worst, as the damp of the valleys below; and they can soon be wonderfully modified by evergreen screens properly placed.

In the second place, make your location as near good neighbors as you can. It is a good thing to learn to live peaceably with our fellow-men, to help them, and to have their help at times. And the time is coming, I think, when neighbors will co-operate in work more than they do now, especially in removing all fences except those required to confine their own cattle.

Vicinity to school and church is a great advantage; though I believe the time is coming when much more of the education of the children, both intellectual and moral, will be done by parents than is now done. Still, the good school is the great thing now to aid in training our children; and the moral, religious, and social effect of the church, and the proper observance of the sabbath, are in no place more beautiful in their effect than in the farmer's home.

Having made his location, let the thought be, This is to be my home, — the home of my children, and perhaps of my descendants for generations to come: at any rate, it is my business, first of all, to create here the conditions of the happiest and best of human life for myself, and for those who come after me. Such thoughts and such efforts make a man more manly and noble; and in no place have they so much to respond to them as on a farm, for the farmer can ordinarily feel sure that his home, if wisely chosen, can continue a home for generations. In the city, the demands of trade sweep away the houses on whole streets. In the city, too, there are simply houses filled with families; but there is no family homestead to remain with all its sweet surrounding associations, as it is possible for the home to remain in the country for generations. And this possibility of country life is one of its greatest charms.

If the farm chosen has already a house upon it, the first question is, Is it in the right place? There is not one chance in twenty that it will be properly planned and constructed. That can be in a measure remedied. If it is in the right place, then begin to plan for it: if not, then select the true place, and begin at once to plan for that, if not for yourself, for the one who is to come after you. Let the permanent work of the farm, the planting of trees, the cutting of trees, and all other farm changes, have reference to the ultimate place of residence on the farm. Wise forethought will make a little labor of great future value to the place for yourself, or for sale.

Let trees be set that in time shall become grand oaks and elms to form stately avenues and noble clumps, so that the house, however humble, may have the advantage of these grand creations of nature. I do not advocate planting stiff rows of trees to shut the sunlight out of the house, nor the surrounding of your house with an indefinite thicket to keep the ground damp, and breed mosquitoes, as is sometimes done under the rage for raising trees and shrubbery.

But I would advocate the planting of long-lived trees that shall be grand in their growth, allowing air to circulate among them, and sunlight to reach the ground between them. If my ancestors had spared some of the grand old oaks which once grew on my place, or had planted some in

proper places instead of seedling apple-trees that never did any good, and are now gone, the value of my place could have been doubled to me by fifty or a hundred trees properly placed. I have set them for those who are to come after me, and have gone over my grounds with my pockets full of nuts and acorns, planting them wherever I thought a tree ought to grow. If too many come up, the axe can thin them; and there is just as much need of cutting down a tree that is in the wrong place as there is of planting one in the right.

Then let the inside of the house be pleasant. It may be small and plain, but let it show signs of culture and taste. This the wife will care for, if she is not overworked, and is encouraged. Make the home pleasant to your children. Do not overwork them, but teach them to work. Dress them as neatly as your means afford. Give them advantages of school when you can. Allow them recreation; and, while you govern them, do not forget they are children, and that they have innocent tastes and desires which you have outgrown, and may therefore consider of no importance.

Make a childhood for your children. It is a protection against a hard and vicious manhood, — a source of joy and delight to them as long as memory shall remain.

It is superfluous, perhaps, for me to say more about the education of your children; but let me beseech you not to educate *off* from the farm. After the simplest rudiments of reading, spelling, and arithmetic, and even with those, see that your children are taught to study nature, to delight in plants and animals and stones and chemical changes, — all the things that daily meet them on the farm. If they cannot get these common, essential things in school, teach them yourselves. If you do not know them now, learn them. The farm furnishes the whole range of plants and animal life upon which one can spend a lifetime of study, and become an Agassiz in observation, if specimens alone were needed. And the farm and kitchen are a laboratory; and a boy or girl who understands the common changes going on in these need not go to the scientific schools to see experiments. Nature is making them daily; and the daily operations of the household are a series of experiments, only they are performed under the homely name of work, without

being understood. Look after the instructions in your schools, and see that they leave out arithmetical puzzles in which most arithmetics abound, geography that nobody cares any thing about, or that will be changed in ten years, and grammar before the child is old enough to possibly understand what he is studying: in other words, save your children, if possible, from the terrific waste of labor too common in schools, and see to it that they know what will be a delight to them in field and house, and what will fit them to be useful citizens. Here stop with school education, unless your children, of their own free will, wish to go farther: in other words, send your children to school, and fit them to be citizens, but never *send* them to college. If they go there, let them go of their own choice; because they ought not to be allowed to go till they are old enough to choose for themselves. Sending a son to college is, in general, about the poorest thing a father can do for his son. The majority of those sent to college would be much better off at home in some honest employment. It would be better for them mentally and morally, and better for the world.

I might thus go on almost indefinitely filling out the programme of duties and grand possibilities of farmers' homes; but time admonishes me that I must stop somewhere, and an outline picture is often the best.

My desire has been to make such suggestions as shall lead the farmer's family to feel that theirs is the favored lot among men, and to encourage such life on the farm as shall tend to keep the children there. Enough of them will be drawn off by peculiar tastes (and especially by that false glare of business life), that look so grand in the distance, and by the peculiar honors of professional life. But it is a great gain, if in all their strife in the market, office, or legislative hall, they can have ever with them the sweet influences of an early life on the farm, and be drawn to it again as they find the emptiness of the prizes of money and honor which come even to the most successful in city life.

I believe the farmer's home will continue to improve, and that the farmer's home of the future will be a place of honest labor, of generous culture, — the best place in which to begin life, a good place to spend it, and the best place for it to come to a close. The only entailment of property we

want, is the continuance of the old farmer's household from generation to generation in the same family, because it is a place worthy of preservation for its conditions of high physical, intellectual, moral, and social life.

Adjourned to Thursday at ten o'clock.

THIRD DAY.

The meeting was called to order at ten o'clock; and a vote of thanks was passed to the agent of the cotton-gin manufactory, and to the superintendent and others connected with the Bridgewater Iron Works, for the invitation to visit their respective establishments, and for the courtesies extended to the members of the Board and others during the visit this morning.

The CHAIRMAN. At a meeting of the members of the State Board of Agriculture, held this morning, a vote was passed tendering their thanks to the officers of the Plymouth County Agricultural Society, and also to the citizens of Bridgewater, for the courtesy they had extended to the Board, and for their attendance on the meetings generally.

It only remains for me to announce that the presiding officer of the day is Capt. MOORE of Concord.

Capt. MOORE. Gentlemen, the first business is a lecture by Mr. J. W. SANBORN of the New Hampshire Agricultural College.

ANIMAL GROWTH AND NUTRITION.

BY J. W. SANBORN.

Farming may have some truths of universal acceptance that are axiomatic in their nature, but principles of general acceptance among farmers it has few or none; yet laws undeviating govern in each department of husbandry. Those that control the growth and nutrition of animals are as undeviating as those that hold the earth in its courses. I feel confident, that, if the known laws and accumulating facts that bear on animal growth and nutrition were applied in Massachusetts, the annual saving would rise above millions

of dollars. Excusing myself from a methodical discussion of the subject, I propose to review some of the laws of animal growth and nutrition, and state facts, accumulated from personal work and the work of others, that bear directly upon economical animal growth.

For my purpose, a review of some fundamental facts, for those who are not familiar with them, will be both suggestive and important.

	Lean Ox.	Fat Ox.	Fat Calf.	Fat Pig.
Fat	7.1	26.80	13.10	40.20
Proteine	15.8	13.70	15.30	11.00
Ash	–	3.90	4.50	1.80
Water	–	43.60	60.19	42.00
Phosphoric acid . .	–	1.56	1.64	.73
Lime	–	1.74	1.93	.77

The above table reveals facts in part commonly understood, and suggests the inquiry whether the calf, containing more proteine than fat, needs to be fed like the ox, containing twice the amount of fat that it has of proteine. The proportion of phosphoric acid and lime, of fat and proteine, to the water of the calf, indicates the progressive changes it must undergo before the period of maturity; and the difference between the calf and the lean ox or the pig leads us to the conclusion that animals so unlike should not be fed alike, and that the same animal should be nourished differently at varying stages of its growth. A mature animal is making neither proteine nor fat, but maintaining the action of digestive and vital organs and heat of body only. Again, we have the butter-cow and ox at work, the growing steer and the fattening steer. These considerations show that feeding is a complex science, requiring skill of a high order.

COMPOSITION OF FOODS.

If it is true that animals kept for diverse purposes, or those of differing stages of maturity, require varying proportions of fat, proteine, etc., can these materials, in practice, be given in the specific amounts desired? The following table is made up from analyses of the products that I have

used in feeding, and from other sources, but principally from a compilation by Dr. E. H. Jenkins, in report of Connecticut experiment station. I have applied to these the German digestion percentages, and get the following number of pounds digested in a hundred pounds of American foods: —

	Proteine.	Carbo-hydrates.	Fats.	Ratio.
	LBS.	LBS.	LBS.	
Average 14 analyses of Timothy-hay . .	4.25	42.13	.97	1 to 10.4
Average 5 analyses of clover-hay . . .	5.00	39.26	.92	1 to 7.4
Average 4 analyses of Hungarian hay . .	4.49	41.05	.59	1 to 9.4
Average 9 analyses of low-meadow hay . .	3.34	35.79	.75	1 to 11
Average 2 analyses of oat-straw . . .	2.42	38.95	.86	1 to 17
Average 9 analyses of corn-fodder . . .	.75	7.10	.07	1 to 10
Average 4 analyses of cured corn-fodder .	2.82	43.47	1.03	1 to 16
Average 3 analyses of cotton-seed meal . .	35.57	12.79	14.35	1 to 1.3
Average 18 analyses of wheat-bran . . .	7.71	49.55	3.07	1 to 7.3
Average 9 analyses of corn-cobs . . .	.94	44.49	.11	1 to 47
Average 10 analyses of linseed-meal . .	24.72	22.90	10.51	1 to 1.9
Average 1 analysis of barley	10.58	60.75	2.11	1 to 6.2
Average 2 analyses of oats	7.32	45.12	3.85	1 to 7.3
Average 31 analyses of flint corn . . .	8.98	66.01	3.87	1 to 8.3

For the convenience of those who may wish to use the table of digestive amounts, I give a table made from such facts as have come to us from German work.

Digested from One Hundred Parts of following Foods.

	Albuminoids.	Carbohydrates, including Fibre.	Fats.
	LBS.	LBS.	LBS.
Good hay	63	60	39
Clover	51	59	45
Oat-straw	47	49	34
Wheat-straw	26	41	27
Rye-straw	49	42	30
Potatoes	64	95	100
Corn-cobs	43	51	28
Turnips	76	86	100
Corn-fodder	72	69	77
Fodder-corn	66	66	40
Barley	80	81	68
Oats	76	64	76
Corn	84	92	75
Linseed-meal	84	60	89
Cotton-seed meal	84	46	90
Wheat-bran	61	72	89

From the above table of amounts digested (for it is only the amounts digested that are given a value in feeding) it is seen that any desired amount of proteine can be supplied with the coarser foods. Thus, if corn-meal given to a calf failed to furnish the desired amount, barley, linseed, or cotton-seed would replace it to advantage.

Proteine, or albuminoids, finds its distinctive function in construction of muscle (lean meat), tendons, ligaments, and cartilage. No other portions of a food can fill its place, as they are devoid of nitrogen. Proteine forms fat, may support heat in case of necessity, and is assumed by many physiologists to be the source of force. The chief function of carbohydrates is to maintain the heat of the body. This is contended by many, with much show of reason, to be the source of force, and a possible source of fat, and in some animals a certain source of fat. The fats of food have their distinctive field in fat formation, but may be a source of heat, and possibly of force. The minerals, or ash, are the basis of the bony frame-work, and have other offices in animal organization. Time will forbid a consideration of this part of the question. I will simply add, that I have found it essential, especially with pigs, to add some source of lime to the food given.

The science of feeding, then, consists, not merely in giving hay or grain, but in furnishing the requisite amount of proteine, carbohydrates, fats, and ash, daily, in amounts sufficient for the growth of the animal, or the purpose for which it is kept. With this view, hay cannot be looked upon as a perfect animal food; for, while the maturing animal changes at each period his relative demand for proteine, etc., that of the hay remains fixed. I will give the following table, and illustrate.

The Germans recommend, from their experiments, the following amounts, daily, per thousand pounds live weight: —

	Proteine.	Carbohydrates.	Fats.	Ratio.
	LBS.	LBS.	LBS.	
Ox at rest	.7	8.0	.15	1 to 12
Ox at hard work	2.4	13.2	.50	1 to 6
Milch cow	2.5	12.5	.40	1 to 5.4
Fattening oxen first period	2.5	15.0	.50	–
Growing cattle from two to three months old (weight 150 lbs.)	.6	2.1	.30	1 to 4.7
Growing cattle from three to six months old (weight 300 lbs.)	1.0	4.1	.30	1 to 5
Growing cattle from six to twelve months old (weight 500 lbs.)	1.3	6.8	.30	1 to 6
Growing cattle from twelve to eighteen months old (weight 700 lbs.)	1.4	9.1	.28	1 to 7
Growing cattle from eighteen to twenty-four months old (weight 850 lbs.),	1.4	10.3	.26	1 to 8
Growing cattle from two to three months old (weight 150 lbs.)	4.0	13.8	2.00	–
Growing cattle from three to six months old (weight 300 lbs.)	3.2	13.5	1.00	–
Growing cattle from six to twelve months old (weight 500 lbs.)	2.5	13.5	.60	–
Growing cattle from twelve to eighteen months old (weight 700 lbs.)	2.0	13.0	.40	–
Growing cattle from eighteen to twenty-four months old (weight 850 lbs.)	1.6	12.0	.30	–

I find, as the result of much weighing, that seven steers, weighing five hundred pounds each, will consume, in round numbers, a hundred pounds of such Timothy-hay as we raise on our College Farm. By the table it will be seen that these steers need nine pounds and one-tenth of proteine daily, and forty-seven pounds and six-tenths carbohydrates. Our hay furnishes, by Professor Collier's analysis of it, five pounds and

four-tenths digestible proteine, and forty-five pounds and five-tenths carbohydrates; which shows a lack of a small per cent of the requisite amount of the latter, and a very heavy one of the former. How shall the amount said by the Germans to be desired be filled? The great food of the East has been corn-meal. If now, to the hay-ration, twenty-five pounds of corn-meal is added, about eighty pounds only of hay will be eaten, and then we will have the sum of five pounds and eighty-six hundredths proteine and fifty-two pounds and eleven-hundredths of carbohydrates eaten, — an excess of the latter, and still a heavy deficiency of the former. We have given a carbonaceous food where a nitrogenous (proteine) food was needed. Looking down the table, we find cotton-seed meal rich in proteine; and using it, we find that but little over half of the quantity used in corn-meal, with the lessened amount of hay eaten by its use, will give the requisite amount of proteine, and very closely to the desired amount of carbohydrates. In practice, I find that a hay-ration alone gives me a growth, in average cases, of a pound a day, — certainly not a full nor desirable growth. By the addition of corn-meal to a hay-ration for growing steers, I have found less hay to be eaten by nearly the weight of corn-meal given; but, owing to the superior richness of corn-meal in digestible carbohydrates, an excess of carbohydrates has been eaten, and the slight increase of albuminoids, or proteine, in the ration, has been followed by only a moderate increase of growth, and yet less than desirable. These facts, coupled with the deductions of German investigators as shown by the last table, leads to the following statements of some of the accepted facts in the new science of feeding.

The first is virtually a repetition of what has already been stated, — the object for which an animal is kept cannot be best attained, unless a proper proportion of each of the constituents of a complete food is daily given.

Again: the most economical use of a food cannot be made where, although enough of each constituent is given, there is an excess of one; for that which is fed in excess is mainly thrown off in the waste of the system. It would be bad practice to add to a food already over-rich in albuminoids another food relatively rich in the same constituent. It will thus be seen that clover-hay for a growing steer of eight

hundred and fifty pounds would not be so appropriately supplemented by cotton-seed meal as by corn-meal.

The relative value of a food when fed alone, as determined by German tests, is measured largely by the relative digestible amount of the deficient material present. Thus, if enough of a given food were consumed to furnish all the minerals, fats, and carbohydrates needed for the most rapid growth, and yet containing only one-half of the needed amount of albuminoids, no continuous rapid growth would be possible: economy would demand the addition to it of an albuminous food.

The reason why the coarser foods, so common with us, — straw, corn-fodder, and swale-hay, — are so lightly esteemed, is due to the deficiency of albuminoids; that the value of these coarse foods can be greatly enhanced by the addition of albuminous meals.

Looking down the table of amounts of albuminoids required for growing animals, it is noticed that a calf, in proportion to weight, requires twice the amount of albuminoids, daily, that is needed by a seven-hundred-pound animal. Again, looking down the table of amounts of nutrients digested in a hundred pounds of the various foods given, it will be seen that oat-straw, swale-hay, etc., are poorer in albuminoids than good hay; yet it is a popular belief that young animals will thrive better with poor foods than older animals. This belief is carried out in practice. The ratio of low-meadow hay in the table is one pound of digestible albuminoids to eleven pounds. The ox at rest only requires from one to twelve pounds; the eight-hundred-and-fifty-pound steer, from one to eight; while the calf needs from one to four and seven-tenths. Even the hay richest in albuminoids falls short of this material in sufficiency for the calf. This policy of feeding poor foods to young animals, without appropriate grain, should be reversed in the interest of economy. Farmers frequently assert that they know that their young animals do better on the poorer foods, eating it better than their older animals. This is perhaps true, and is due to the fact that young animals have a vigorous appetite, consuming more, and gaining more, in proportion to weight, than older ones. At the growing period it is a great mistake to rely upon a vigorous appetite to utilize inappropriate food: it is a sacrifice

instead of an economy. I have known instances where a half-truth had been mastered; and with the poor foods albuminous grains or meals have been fed, but in amounts to correspond with the weight of the animal. In practice, we cannot bring our methods to scientific accuracy for various reasons; and it is a sufficient approximation in practice to say, that, if one were feeding calves, yearlings, two-year-olds, and three-year-olds, with one meal to supplement a coarse food, each animal would require substantially the same amount. As an illustration, I find in practice, that, in round numbers, eleven calves, weighing three hundred pounds each, will consume a hundred pounds of Timothy-hay. They would require ten pounds and fifty-six hundredths digestible albuminoids; while the hay will furnish but about four pounds and a quarter, making a deficiency per calf of fifty-six hundredths pounds daily. I find that five eight-hundred-and-fifty-pound steers will consume a little over a hundred pounds of hay. These five require, daily, eight pounds digestible albuminoids, but get in the hay only a little over four pounds and a quarter, or a deficiency of fifty-four hundredths pounds each. I find on account of their vigorous appetites, and for other reasons to be named, that it is desirable to feed our young stock, as well as older animals, on straw, corn-fodder, or poor hay; but, so long as they are kept for growth, always accompany such ration by an amount of grain quite uniform at varying ages.

It is a quite prevalent opinion that the larger breeds of fine animals are the necessary product of excellent foods, and are not the common animal of the farmer. The good animal is always the product of plentiful food; but in experimental inquiry I have noticed that the best animals were always like the young animals alluded to above (those of good appetites): I have thus found them the best feeders of coarse foods. It is the stinted animal that has the rebellious appetite. The larger and better beasts have good digestive and assimilative capacity. Successful feeding with the pig, steer, or cow, in New England, depends upon naturally good animals, with vigorous appetites and good digestive and assimilative powers. If a poor animal is to be kept, it might be questioned whether it will pay to feed on the high-pressure system. Certainly it can be overdone more easily with the

poor cow than with the good cow. I have frequently noticed, in feeding-experiments with cows, that an increase of food is not always accompanied with a similar increase of milk-flow, With steers, the following illustration will show the importance of the good steer. Four two-year-old steers were fed in two lots. Lot 1, when meal was added to its former hay-ration, ate four hundred and forty-six pounds, and three hundred and thirty pounds less of hay than when meal was not fed. Lot 2 ate five hundred pounds meal; and this took the place of five hundred and eighty pounds of hay. The one used the meal, in part, as excess food; while the other lot used it to slightly more than replace the hay. The first lot gained very much more than the second. But from this partial digression I will return to the amount of food eaten by animals of differing ages, and briefly notice a most important law of animal development.

The older and larger an animal grows, the more food is required for a pound of growth. That young beef or pork is cheap beef or pork is receiving recognition, but not to the extent that its importance warrants. Possessing a less vigorous appetite, and perhaps digestion and assimilation not so active, and less surface for radiation of heat in proportion to weight, the steer and pig approaching maturity are now understood to make better use of a pound of food than younger beasts. Those who observe that young animals eat more than old ones in proportion to weight are correct; but it by no means follows that a proposition like the following is true, — a proposition that many still stoutly maintain: "My pigs are great eaters, and I know that my shotes don't eat much more, and are more profitable to feed." Such an error is destructive of all chance to feed economically either steers or hogs in New England. The heavy consumption of food by young animals is the very reason why they make better use of food. While the truth I am presenting is somewhat trite with the well-informed, yet its importance and non-observance in practice will warrant the presentation of a few facts to enforce attention to a law as immutable as those that control the movements of the planetary systems. In three experiments, calves weighing four hundred and twenty-five pounds ate three and three-tenths per cent of live weight daily, and required ten pounds of hay to make

one of growth. Two younger and lighter ones ate more, and required only seven pounds and seven-tenths hay to make one of growth.

Five experiments with steers weighing seven hundred and fifty pounds gave a consumption of two and six-tenths per cent of live weight daily, and nineteen pounds and a quarter hay for one of growth. In a multitude of experiments with steers of weights varying from eight hundred to eleven hundred pounds, they would eat two and five-tenths per cent, or less, of Timothy-hay, and gain about a pound a day, requiring still more hay to make a pound of growth. The gain per day has not, in summer or winter, varied much with our animals of differing ages, but is generally greater with young animals; as a study of English lists of premium cattle, and those of the great cattle-show held at Chicago for a few years past, will make evident. The great cattle-show at Islington for 1879 revealed the following figures: Up to two and a half years of age the shorthorns grew two and six-hundredths pounds daily; from two and a half to three and a half years, one and seventy-nine hundredths pounds were made; and from three and a half to four and a half years, one and sixty-two hundredths pounds only of daily growth were made. At the last Chicago fair, larger growths were reported, but the same general facts were revealed. It will not fail to be noticed, that, while the larger animal grows less per day, this lessened growth is made upon an increased consumption of foods; as, in instances cited from our College Farm experiments, less hay to calves (seven pounds and seven-tenths) were required to make a pound of growth than would be required to maintain the existence of a thousand-pound steer. I find that such a steer will require as food of support, upon which no gain will be made, about eighteen pounds of hay a day, or over twice the amount required to make a pound of gain on young things. As it is by no means wholly a question of age, but more largely of increased weight, that cost of beef or pork increases as age and weight increases, the objection has to be met, that price increases with size, and that a certain size is necessary. This is all true; but it should stimulate to the breeding or selection of a type of cattle that will bring the highest market rates on the

least weight. I have noticed the highest market quotations for steers carrying no more than from twelve hundred pounds to thirteen hundred pounds of live weight outselling others of from sixteen hundred pounds to eighteen hundred pounds. Again: steers can be put on the market at its highest rates on two winterings and September sale, but four years represents nearer the average of New-England heavy beef. If fatted at two years, instead of four, two winterings and keep for two summers are saved. As the average weight of such a steer for the whole period of life would be, in round numbers, eight hundred pounds, if sold at a weight of fifteen hundred pounds, the saving would amount to two tons and forty-five hundredths of hay, and two summerings, of a total value of from forty-five dollars to forty-seven dollars, hay being rated at fifteen dollars per ton. This is on the basis of facts taken by me, which show that food of support for an eight-hundred-pound steer is, in round numbers, fourteen pounds daily. If sold at two years, this food of support is saved from this time to four years of age, as all growth is made on food given above this amount. To the above facts bearing on this subject, a mass of facts could be added from personal weighings and from weighings of others; but it will suffice to fix the importance of attention to this matter. Whether the German table is right, or not, as to the relative amounts and kinds of nutrients needed at varying periods of animal development, it is certain that an animal when young needs more of the albuminoids than at the mature period, that a young animal needs more food than at a later age, and that a pound of food is of more value to the young animal than to one of mature age.

GERMAN TABLES.

The value to the world of German investigations of foods and feeding-problems is in no danger of being overvalued. Their conclusions have been embodied in tables and propositions. These are widely circulated, and very readily accepted. I recall an instance in German work where steers were fed in stalls of unlike temperature, and the rations fed; and their results were considered to be modified by this fact, and the conclusion drawn, that steers in the warmer stalls appropri-

ated more food, and, in all probability, more of the carbohydrates. Our soil and climate are different; and consequently our herbage, as climate and soil affect herbage, is different. These facts will be seen very prominently, if comparison is made with the hays analyzed thus far in this country. Timothy, in nine analyses, shows six and sixteen-hundredths per cent of albuminoids; while nine and seven-tenths per cent is the reported average by German tables, ours being richer in carbohydrates than theirs. Our climate is colder, and the humidity of our atmosphere unlike theirs. The authorities quoted here have been those who have favored the view that albuminoids are the source of fat, force, and flesh; and these views color their conclusions, — at least this appears in much of their work. Hence we have tables of food-values based on four cents and a third as the value of a pound of digestible albuminoids, while nine-tenths of a cent per pound is their rated value for a pound of digestible carbohydrates.

I do not wish to enter into detailed statements, to show that facts for Germany may not be applicable to America, but merely to suggest that some American review of their work is called for. Their tables of food-values, based upon the prices named, are mischievous in their workings here; for I find, following the advice of prudent men, so esteemed, many farmers are rating foods of the market on these tables. The samples of cotton-seed meal that have come into my hands contained a greater value of digestible albuminoids, on their basis, than the cost of the meal; so that the other constituents go for nothing. They (the Germans) have cotton-seed meal rated at three dollars and sixty cents per hundred pounds, hay being rated at a dollar per hundred pounds; yet cotton-seed meal can be bought for less than one-half this amount. This is an extreme case, but will serve to show the fallacy of the basis. Messrs. Lawes and Gilbert, in their celebrated feeding-trials, came to a conclusion opposite those of the Germans, — that the value of a food is measured more by its resource of available carbohydrates for the very simple and common-sense reason, that in English markets foods were easier obtained that were rich in albuminoids than those rich in carbohydrates. I think I can show, from five years of exact weighings, that it is easier and cheaper to get growing

cattle to consume a sufficiency of albuminoids than it is to induce them to eat a plenitude of carbohydrates. The cheap sources of carbohydrates are in unpalatable foods, that will not be eaten in sufficiency. I have ventured these suggestions in the belief that tables are at present working a double mischief, — first, in fixing the almost exclusive attention of feeders upon the necessity of getting the albuminoids, while the practical weakness of this ration will be found in the lack of carbohydrates; and, second, in ascribing a false value to foods as found on the American market.

The economy of food combinations in practice is the final standard by which the farmer will measure the value of theoretical deductions. It must not be forgotten, however, that German conclusions, in many of their most important phases, rest upon actual trials.

I will state, before giving results, that they are for two-year-old steers, in lots of two; each lot of like weights and ages, and, for the immediate part at least, of like feeding, and, in most cases, of similar breeding. No attempt has been made at high feeding for rapid growth; the purpose being to put with the common coarser foods of New England — such as straw, corn-fodder, and swale-hay — such concentrated foods as the markets afforded, feeding in moderate amounts, as customary with farmers. These combinations have uniformly been fed against good hay. The purpose has been to note the economy of the combination, the amount of each of the nutrients in each ration, their comparative efficacy by the side of published German results. The following statements cover but a fraction of the trials made, and are given so as to show the results with as many foods as possible. When hay is repeated, it is for another set and year. More lots were fed each year, but many were repetitions. The facts to be given are considered sufficient to demonstrate the economy of the combinations, at least for moderate growth. Hay, good Timothy, cured, rated at $20 (as it is guessed that for 1881–82 this price may be an average for the Massachusetts farmer); cotton-seed meal, $32; corn-meal, $30; bran, $25; fish, $50; new-process linseed-meal, $32; blood, $45; meat, $45; clover, $20; straw, $10; corn-fodder, $10; and swale-hay, $10 per ton.

1878.—*For Seventy Days.*

Lot.	Feed.	Gain.	Cost per day.
		LBS.	
1	Swale-hay 35.6 lbs., and 4 lbs. each cotton-seed meal	167	$0.306
2–8	Timothy-hay 48.5 lbs. for lot of 2, average of 2 lots	124	.485
3	Straw 34.6 lbs., and 2.5 lbs. each corn-meal	120	.248
4	Straw 33 lbs., meat 2 lbs., and corn-meal .5 lb. each	81	.27
5	Straw 35 lbs., blood 2 lbs., and corn-meal 1 lb. each	133	.295
6	Straw 15 lbs., and clover 25 lbs. . .	150	.325

1879.—*For Forty-nine Days.*

Lot.	Feed.	Gain per day.	Cost per day.
		LBS.	
1	Timothy-hay 46 lbs.	1.40	$0.463
4	Straw 26 lbs., fish 2 lbs., and 1 lb. corn-meal each	2.75	.260

1880.—*For Forty-nine Days.*

Lot.	Feed.	Gain per day.	Cost per day.
		LBS.	
1	Timothy-hay 43 lbs.	1.41	$0.430
2	Straw 22.8 lbs.	(Loss.)	.114
3	Straw 19.2 lbs., and 3 lbs. each new-process linseed-meal	.87	.192
4	Straw 19.2 lbs., and 3 lbs. each bran .	.92	.171
7	Straw 19.3 lbs., and 3 lbs. cotton-seed meal	2.75	.182
8	Straw 16.6 lbs., and 3 lbs. each mixed meals	1.25	.165

Corn-fodder has also been tried quite extensively with favorable results. While the above figures may be safely left to tell their own story of economy, yet there are several facts that it suggests to which I wish to call attention. First, several of the combinations of straw and grain gave as good growth as the Timothy ration; and the straw is made, by the combined ration, as valuable as the hay. Take, for

illustration, the fish ration: it gave better growth than the hay to the lot by its side. The fish and corn-meal in this ration cost thirteen cents. If we subtract this cost from the cost of the Timothy to lot 1, or forty-three cents, we have thirty cents; or it seems that twenty-six pounds of straw, then, did better business with the fish, and netted thirty cents, as a substitute for hay. In many trials with clover and oat-straw, I have universally got as good results from clover and straw combined as from Timothy alone: in other words, either straw is worth as much as hay in the ration, or clover is a better food than hay. The real truth of the matter is, both foods are worth very much more when fed together than either would be fed alone: at least, such has been the case with us at the College Farm. They are foods complementary to each other; and each prevents the waste of certain materials in the other, if it were fed alone. Clover is rich in albuminoids, and less so in carbohydrates than straw; while straw is poor in albuminoids.

Millions are annually wasted in New England from the hasty acceptance of palatableness as a measure of food-values. The figures given illustrate this. In 1880 lot 1 ate forty-three pounds of Timothy, and made a gain; while lot 2 ate but twenty-two pounds and eight-tenths straw, and returned a loss. This is no evidence that straw is good for nothing as a food, but is evidence that twenty-two pounds and eight-tenths of straw is not worth as much as forty-three pounds of hay.

From what has already been said, it will be seen that two steers, weighing seventeen hundred pounds, eat thirty pounds of hay daily for mere maintenance; and, had lot No. 1 received but twenty-two pounds and eight-tenths of hay, they, too, would have lost weight. But would that have been an evidence that hay is good for nothing but bedding? The truth is, that oat-straw, swale-hay, and like foods, have been sadly under-estimated, not merely because of their deficiency in albuminoids, nor because of indigestibility, so much as from the fact that they are unpalatable, and hence not eaten in amounts sufficient for growth. Whenever, by skill, the feeder gets them eaten, they each of them, to the extent eaten, become nearly as valuable as Timothy-hay. This same mistake in regard to palatableness has led us into other mistakes equally

grievous; for instance, in regard to early-cut hay. But I have not time to trace the matter out in all of its relations, and will simply say, in relation to the time of cutting our grasses, that experiments at our farm leads me to deny the correctness, in most particulars, of prevailing views in regard to the proper time to cut hay or fodder crops.

When two sets of steers or cows have been changed from straw, corn-fodder, and clover, and lot 1 fed with hay cut in bloom, and lot 2 fed with hay cut fifteen days after full bloom, or when seed is well formed, those fed upon either lot will consume like amounts, and the latter make the better use of their food. Now, when I change from early to late cut hay, those thus changed will eat less than formerly; or, noting a case in point, from forty-three pounds of hay cut in bloom, thirty-two to thirty-five only were eaten when fed on hay cut subsequent to bloom, or little more than maintenance-fodder. This decreased amount eaten does not remain permanently so, but will remain less than forty-three pounds for perhaps three weeks. Not understanding the reason why, farmers, from noticing the effect of the decreased consumption, have drawn the unfortunate conclusion, that late-cut hay is deteriorated hay. This is a mistake, unless cut later than the formation of seed. These latter facts have not been introduced to discuss the broad question of changes in maturing crops, but to give a fact in opposition to the policy so frequently and tenaciously urged.

The instance given, which might be multiplied by those of like tenor, shows that the change from a palatable to an unpalatable food is followed by decreased consumption, the effect of which may extend over much time. The policy of change of foods to give appetite, etc., is all right, so long as one can change from an unpalatable to a palatable food, but not otherwise, as it will have to come about in a round of changes.

In making changes, there will come periods when animals will gain little or none; yet it is just now favorite advice to change food. By thus doing, the appetites of stock are kept unsettled.

MANURE-VALUE OF FOODS.

We cannot divorce the question of the manure-value of foods from feeding-problems. The central motive of the

New-England feeder is to obtain food for his crops. As well with us as with the English farmer, should the manurial value of a purchased food be the first consideration. A very much higher method of farming than is now practised by us is soon to be the rule. The great necessity will be to provide a heavy increase of plant-food. Two prominent sources of it are open to us, — the purchase of rich, manure-making foods, and of chemicals. I use both sources, but feel confident that the former is the cheaper source, — cheaper only when good animals are fed in economical rations, and matured young. Early beef, cheap beef; cheap beef, cheap manure; cheap manure, cheap crops. This moral, applied to pigs, gave me, during several seasons, twenty-six pounds and four-tenths pig for a hundred pounds of corn-meal, and twenty-nine pounds and one-tenth for a hundred of middlings. Here the product pays for the food; and in the middlings we have a food worth over twice as much for manure as the corn-meal. With calves, when weights have been kept from the first of feeding, the cost at three weeks of age was but little over two cents for a pound of growth, up to a weight of three hundred and fifty-two pounds; then the cost became four cents per pound of growth. The average cost was three cents and one-tenth per pound. They were then good veal, and salable for a considerable advance over cost. Yet, with grade Durhams whose accounts have been sufficiently well kept, I have found them, at two years of age, worth more than cost. With sheep and good butter-cows, well managed, better results might be expected. I only maintain that manure from animals can be got for attendance, which is cheap manure under a right system of food-selection. It is to this feature that I call attention. The fish used (see table) was the material, ground and dried, that is used for ammoniating fertilizers: therefore it was a manure that was fed. And inasmuch as only from five per cent or less (as in the case of potash) to about twenty per cent sometimes (as in the case of nitrogen only) of the food enters into the growth of a beast, and inasmuch as that portion of a food given that is thrown off at the lungs and skin has no assigned value as a fertilizer, it follows that eighty per cent and upwards of the food fed is found in the manure-heap. I paid fifty dollars a ton for fish (an

amount which the market accepts as its value for a fertilizer), and yet received, when fed against hay, more than I paid for it as a food, and still had eighty per cent of my fertilizer left, or forty dollars' worth. This is "eating your cake, and having it." It is unnecessary to quote tables of manure-value of food, they have become so common; but by them it is seen that cotton-seed meal has a manurial value of over four times that of either good hay or corn-meal. To test the manurial value of cotton-seed meal of the ration given, I used at rate of a thousand pounds per acre, and received at rate per acre of forty-nine bushels and four-tenths corn, and sixty-nine hundred pounds stover. A section unmanured gave twenty-four bushels and nine-tenths corn, and twenty-four hundred and eighty pounds stover: cost of cotton-seed meal, fifteen dollars; value of excess growth over unmanured plot, thirty-five dollars. Messrs. Lawes and Gilbert fed a given number of sheep, over two acres of ground, with a ton of cotton-seed meal; by side of same an equal number of sheep, over a companion two acres, were fed a ton of corn-meal: they harvested in first season and first crop of second year fifteen hundred pounds more hay where cotton-seed was fed than where corn-meal was fed. Instances of the use of food for manures can be easily multiplied; and it can be shown, that, at market-rates of nitrogen, phosphoric acid, and potash, the amount of them in many foods (cotton-seed meal especially) is such as to make them often cheaper sources of the named elements of plant-nutrition than chemical fertilizers. The larger portion of the value of a food for manure (of those so valuable nitrogenous foods) consists in the nitrogen it contains; and, as the tendency now in New England is to esteem nitrogen less than formerly, the value of food-tables for manure is liable to be called seriously in question. Practically, I would not esteem foods to have quite the relative theoretical value now given, but substantially so; for, by the use of nitrogenous foods, I would ignore entirely the purchase of nitrogen in fertilizers, using purely minerals; the costly nitrogen being got for a nominal sum by feeding nitrogenous foods, using cotton-seed meal most, because at present, as a food for use with coarse fodders, and as a source of manure, it is cheapest. Let me repeat, that no New-England farmer is a skilful feeder who organizes his rations without reference to the quality of fertilizer his stock (manure-mills) are to make.

NUTRIENTS CONSUMED.

The Germans claim that a thousand-pound steer requires seven-tenths of a pound digestible albuminoids and eight pounds digestible carbohydrates daily, for maintenance-fodder; that practically it makes but little difference whence the source of these materials for actual amount digested. In tens of experiments, covering as long periods as those of Germans, and usually longer, I have uniformly received widely contradictory results of their views; so much so, as to make the matter of much moment. I will give tables of results. The foods, clover and fish excepted, were analyzed by Professor Collier. The analysis of the fish was known. Weight of lots eighteen hundred to eighteen hundred and fifty pounds.

Lot 1. — Feed, good hay.
2. — Corn-fodder.
3. — Corn-meal six pounds, and corn-fodder.
4. — Corn and fish six pounds, and corn-fodder.
5. -- Cotton-seed meal six pounds, and corn-fodder.
6. — Clover and corn-fodder.

In the first table will be seen a column of gains for the last thirty-five days. I have uniformly found, that, when a change is made from a food better eaten, animals lose apparently in stomach weight: thus, when a pair of steers are changed from fifty pounds of hay to thirty of straw and grain, there is a less full stomach; and for the first week, therefore, although the steer is really gaining in carcass weight, I consider the results of gain under column of thirty-five days fairer. Digestible amounts are used in the table ascertained by German digestion percentages.

Lots.	Albuminoids.	Carbohydrates and Fibre.	Fats.	Ratio, Albuminoids to Carbohydrates.	Cost.	Per 1,000 Pounds. Steer per day.			Gain or Loss per day.	Gain per day last 35 days.	Total Organic Matter eaten.	Org. Matter eaten p lt. per day.
						Albuminoids.	Carbohydrates.	Fats.				
	Lbs.	Lbs.	Lbs.			Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	114.44	995.04	56.40	1 to 9.8	$12.63	1.29	10.71	.60	1.81	1.40	1,857	37.9
2	56.51	645.00	23 83	1 to 12.4	6.17	.63	7.40	.26	Loss .33	.45	1,233	25 1
3	74.73	842.07	29.62	1 to 11.9	9.14	.85	9.71	.34	1.00	.57	1,364	27.8
4	158.30	755.12	32.39	1 to 5.4	11.84	1.79	8.01	.55	Gain 2.75	2.28	1,486	30.3
5	143.09	640.31	63.50	1 to 5.5	9.52	1.61	6.66	.71	.53	1.74	1,384	28.2
6	101.39	818.75	25.20	1 to 8.6	10.88	1.12	9.03	.29	1.96	2.45	1,749	35.7

Second period of forty-nine days, straw substituted for corn-fodder; food otherwise the same.

Lots.	Albuminoids.	Carbohydrates and Fibre.	Fats.	Ratio, Albuminoids to Carbohydrates.	Cost.	Per 1,000 Pounds. Steer per day.			Gain or Loss per day.	Ate.	Gain.	Total Organic Matter eaten.	Org. Matter eaten p.lt. per day.
						Albuminoids.	Carbohydrates.	Fats.					
	Lbs.	Lbs.	Lbs.			Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	122.45	1,064.69	60.34	1 to 9.8	$13.56	1.38	11.46	.64	Gain 1.89	2,260	93	1,993	40.6
2	31.38	500.36	11.94	1 to 16.8	4.10	.35	5.65	.12	.65	1,272	32	1,115	22.7
3	51.51	605.96	24.31	1 to 12.9	7.34	.59	6.97	.26	1.08	1,088	53	1,208	24.6
4	132.61	531.24	32.86	1 to 4.5	9.65	1.33	5.34	.33	1.83	1,229	90	1,331	27.1
5	120.50	545.60	39.69	1 to 5.9	7.55	1.33	6.04	.38	1.00	1,213	49	1,458	29.7
6	111.48	930.33	19.44	1 to 8.6	11.63	1.18	9.84	.20	1.32	*1,489	65	1,966	40.1

* 800 straw, and clover 1,489.

Better gains have been received in other trials, but these cover the purpose in view. In the table it will be noticed (in the second period for forty-nine days, per thousand pounds live weight) lot 2 gained on thirty-five hundredths[1] of a pound of albuminoids and five pounds and sixty-five hundredths carbohydrates; while lot 4, given one pound and thirty-three hundredths of albuminoids and five pounds and thirty-four hundredths of carbohydrates, gained nearly a pound each, or a heavy per cent less of digestible material than is accepted as necessary to maintain existence without growth. In no case, for five years, has a combination of grain and straw failed to do much better than German and our authorities claim for the work of a given amount of organic matter. That it does make a difference whence the source of organic matter, this table, and all my experiments at our College Farm, show. Compare the results of straw with corn-fodder and grain, and straw against hay, and a very material difference is at once noticed. Thus for eighty-six pounds of organic matter in swale-hay and cotton-seed meal, seventy-six in corn-stover and cotton-seed meal, and sixty-five in oat-straw and cotton-seed meal, I have received substantially the same results, in the better combinations, as from a hundred pounds of organic matter in Timothy-hay. These facts seem so contradictory to German work,

[1] The amides shown by the analyses are, as by old methods, estimated as albuminoids; so that the actual albuminoids consumed was less than shown by the table. As many of the German foods contained a heavy per cent of amides, their tables are subject to the same, probably greater, discount.

and (in case of straw and grain against hay) so contrary to what would be termed common sense, and (if true) of such vital importance in the economy of the farm, that I am led to say virtually, again, that for five years, in accurate work each year, in every instance the proper meal with straw, and in fact any meal with straw, has done better than the German work upon which Americans now rely would allow. When I say German work, I mean the conclusions they draw from actual trials. From such of their trials as have come to my attention, I find occasionally the full results given. When mostly straw and grain are fed against a pure hay-ration, results are given that agree somewhat with mine; but they are either unnoticed or misinterpreted. That the value of straw is much misunderstood, let us all agree, or in your own interest put my faith and work to a new trial. The causes of the value of these combinations, I am now in further trials seeking, but will only say that I am tracing one that partly meets the difficulty of the facts.

An application I would make of the foregoing facts is to increase the area tilled. Massachusetts raises an average of a ton of hay per acre. It will not weigh out a ton in spring. A steer of a thousand pounds, consuming twenty-five pounds daily, would winter eighty days from an acre of ground. With rotation of crops in broad culture, the corn-crop would soon be made sixty bushels per acre, and three tons and a half stover. This stover would, by my results, keep a steer two winters. Sell corn enough to procure the cotton-seed meal to go with it, and thus introduce a manure food worth four times as much as the corn, and leave corn enough to fat two pigs weighing over two hundred and fifty pounds each, live weight. This statement is based upon three years' results of corn-fed pigs, and results from the use of stover. That the old system of intensive culture, or narrow areas well tilled, with hay prominent, has not been satisfactory, none need be told. Chemicals and purchased foods allow of broad culture, and open greater possibilities to our farmers. Such a system is now pursued on our College Farm with greater profit than I could obtain by the old system. I invite your thoughtful criticism of the change.

RATIONS FOR COWS.

The length to which this subject has been extended forbids the entering into the review of the interesting facts and theories that have come to us from across the waters, some of which an accumulation of facts in my experience at our College Farm would not seem to fully sustain. I wish merely to call attention to a phase of the question that every good dairyman understands, — that while a milch cow must have an abundance of albuminoids and carbohydrates daily, yet we cannot, as with the steer, select these nutrients from any source indiscriminately. When butter is sold, the factor of quality comes in; and the difference in price of good and poor butter is so great, that the food that within certain limits produces the best butter is the most economical. Thus we have, in feeding the cow, the twofold purpose, — to accomplish the forming of a ration that will give a sufficiency of each nutrient of foods, and that will furnish butter of good quality from the cheapest foods that will maintain that quality. In relation to the latter points only, will I now say a word. Corn-meal I find to be a most excellent food for both quality — as regards texture, color, and aroma — and quantity, when fed in right combinations; but its lack of albuminoids in sufficiency makes it necessary to use an albuminous food with it. Bran added affects injuriously the quality and quantity. Oat-meal and pease will maintain the quantity better, but the quality still suffers. Palmer-nut meal is a great butter-producer, but the quality is not right: neither have I been fully satisfied with the brief trials of oil-cake meals. For both quantity and quality, the equal mixtures of corn and cotton-seed meals have proved most satisfactory. The same problem that I found with my steers I find with the cows, — that a cheaper and yet satisfactory ration can be made with other combinations than those in which hay is prominent. I have found corn-stover and fodder-corn excellent butter-producers. The value of our corn-plant to the dairyman is not easily overestimated. With stover, clover, and straw, corn and cotton-seed meals, I find a fodder cheaper than hay and grain effective, and producing a good quality of butter. A change from the first ration, without the clover, into early-cut hay alone, was followed by

a marked decline in milk-flow. I should not care to assert that the texture of the butter from the ration named, that I am now feeding, is as good as from properly-cut hay, and corn-meal. The quality of butter is so varied by various foods, that it requires an expert to detect the nice variations in the quality of butter. Butter from the rations named is of good color and aroma; and I do not as yet know that it is not in all respects as good as from hay.

ENSILAGE.

The advocates of this recent system of preserving fodder represent it to be of the first importance. They offer results for our acceptance, that they claim to be a full realization of hopes extravagant beyond sober calculation. Influenced by these widely-current statements, much farm-capital has already been invested in silos, and large amounts will probably be further withdrawn from agricultural resources for the same purpose. Farmers would not make such a sacrifice of their slender means, except in the belief that a discovery had been made of great value in agricultural progress. With this view, I propose to carefully consider the merits claimed for the silo system; and, in doing so, I will ask some latitude to notice facts that bear but indirectly upon the subject.

It is claimed that the silo enables us to grow fodder-corn to a greatly-increased extent, and that without this method of preservation no such quantities could be grown and cared for economically; secondly, that, by the old process of air-drying, there was a loss of value, and that this is avoided in the silo; thirdly, that the silo affords green food for winter, and that such food is more effective than the same food when dry; fourthly, that the fermentation in the silo renders food more digestible; fifthly, that this fermentation warms the food to blood-heat, and thus further assists the powers of the stomach; sixthly, that experience proves it to require less food to produce a pound of increase, or a given quantity of milk, when ensilage is used. I wish to consider each point, not in a controversial spirit, but with intent to bring out the facts. Of course, every farmer hopes that all of its claims may be substantiated; yet, whatever our desires may be, we must make a cool search for the facts, and accept them.

COST OF SILOS.

Several men present who have silos are represented as working farmers. Each gives me figures of cost that show, for each ton of silo capacity, a cost of three dollars. If we assume an acre of fodder-corn to yield twenty-five tons, it will cost seventy-five dollars for silo-room for each acre of ground, the least interest of which is four dollars and a half; and we have, in addition to that, machinery for handling and cutting up. This outlay is more than the average value of good land, and requires more capital to make pits than to buy the farm with buildings on it. What would seventy-five dollars per acre of stock, tools, chemicals, etc., do for a farm? Yet the pit itself is non-productive.

In answer to the claim that it enables the growth of more food per acre, it may be said that no known facts warrant the statement, while some controvert it. What quantities of fodder-corn are actually raised? In consulting a dozen good farmers, on farms better than the average, only one claimed to have raised twenty-five tons of green fodder; several "guessed" that they had twenty tons, and called it a good crop; more than one-half thought they got but fifteen tons. Desiring to put it at its best, we name twenty-five tons as all the probable average product. Of this, twenty-one tons and a half are water. As three tons and a half of dry matter of hay would carry three-fifths of a ton of water, we find we have to handle about twenty-one tons of water in the green corn-fodder; or, if field-cured as field-corn, this dry matter would carry only a ton and a sixth water, or twenty tons and a third needlessly.

An owner of a silo represented, at yesterday's session, that it cost him one dollar per ton to put his fodder-corn into his silo: therefore twenty dollars and two-thirds is paid for carrying water. Deducting this from the value of the three tons and a half of dry matter of fodder, and a very serious per cent of its value is paid for handling water. Again: this three tons and a half of dry matter I have grown this year in clover at much less cost per acre. Two gentlemen present represent that they have grown, the past season, four tons of Hungarian grass per acre (a crop, like corn, adapted to dry lands). We have in these crops as much dry matter per

acre as in the corn. They are large crops, it is true: so is twenty-five tons of corn-fodder; and, while I believe more of corn-fodder can be grown per acre than of any of the crops named, yet the cost of it, and especially the expense of putting it into the silo, does not show any economy over the other crops named. Thus it appears to me that the silo does not allow us to extend the area of our fodder-crop. I have, for the past year, grown twenty-two acres of field-corn on each of two farms, and find no difficulty in caring for it. Here you have the same plant grown thin enough to mature its ear. In either case, the capacity of the corn-plant to extract nourishment from the soil is reached, — the one reaches maturity, the other not. The first has more of the albuminoids and less of less valuable amides. The first has more of sucrose and less of glucose. Several years of exact work with scales have shown me, that, in the stage of growth of field-corn at beginning of glazing, the hay-crop is larger per acre, and per pound more valuable, than that earlier cut. Three years' feeding-trials with corn-fodder convinced me, that, as the fodder-crop matured, its feeding-value increased. Mr. Cheever, after years of trial by all methods of raising fodder-corn, told you that he is now best satisfied with raising it for a soiling crop, by the field-corn method. My own experience agrees with his, and convinces me, that, where I can raise twenty-five tons of fodder-corn, I can raise sixty bushels of corn and three tons of fodder. The fodder-corn will contain three tons and a half of organic matter; the field-corn, in round numbers, four tons strong in corn and stover. Those whom I consult say they can raise two bushels of corn and its fodder where they raise one ton of fodder-corn. On this basis there would be no practical difference in the amount of dry matter raised by either system; and the mature corn, I assume, will be grown and handled the cheaper, and be of greater feeding-value.

DRYING WASTES — SILO PRESERVES.

Professor Goessmann, who is recognized as authority upon any matter he will express an opinion about in agricultural science, very fully denied both of these propositions at the Massachusetts Board meeting for 1880: hence I will not discuss the matter, but merely make a statement or two. It

seems, by such trials as have been made by the Germans, that hay may be so made as to lose nothing in the process; but at the same time they present facts to show that by over-drying, or making under bad conditions, hay may lose mechanically by the shattering of its leaves in handling, and, as Dr. C. Brimmer says, in case of clover rapidly drying, a loss of both proteine and carbohydrates may occur. While it must be admitted that a loss by the former if not by the latter cause may occur, yet in our favorable climate that loss must be very slight. Still from rains and unskilful practice there may be some loss; but there is not that loss from the evaporation of juices that those unacquainted with the facts assert. Such loss, however, is more than offset by the loss from fermentation in the silo. The character of the changes in fermentation were set forth by Professor Goessmann, a statement of the loss accompanying it. The facts of the trials in Austria and in France are familiar to the public. Professor McBryde, of the Tennessee University, weighed in and weighed out his material, and lost four hundred and fifty pounds per ton in an earth-silo. I am convinced, however, that the losses from the earth-silos do not give a fair basis of loss for a good cement-silo. Comparing Professor Cook's analyses of nine samples of ensilage from nine cement-silos with the average of a sample of fresh corn-fodder as by Connecticut experiment station report, neither the organic materials nor the ash (this ash hardly more than in green corn-fodder) warrant the belief that the losses are so great. in a good, well-managed cement-silo, as have been quoted from the earth-pits; yet the evidence, so far, warrants the belief that the loss in silos is as much or more than the vicissitudes of open-air curing will give. From some facts before me, I find that hay exposed to brief showers does not make so great a loss as is usually apprehended. If but partly dried, or in heaps, the loss would be still less.

GREEN FOODS BETTER THAN DRY.

Mr. Lawes, in a recent article to an American publication, takes a contrary view, and questions whether a green food for winter is the best. He expresses the opinion that Americans are expecting too much of ensilage, and gives us to understand that he has little faith in it. German work is

explicit in the statement that a food properly dried is as digestible as the same food in a green state. In three seasons' work, I have fed from eighty to a hundred pounds of fodder-corn against twenty pounds of hay, and even when the latter amount has been used, the hay has given the best results; yet it is claimed that from forty to sixty pounds of ensilage are equal to twenty pounds of hay. I will give a partial statement that represents the tenor of my results with corn-fodder fed against hay.

Four were cows, fed in lots of two each, in August. Prior to test, lot 1 gave, on pasture-grass, 30.17 pounds milk daily. Prior to test, lot 2 gave, on pasture-grass, 30.60 pounds milk daily. Test or second period, lot 1 gave, on grass and a hundred pounds fodder-corn, 30.44 pounds milk daily. Test or second period, lot 2 gave, on grass and twenty pounds hay, 32.44 pounds milk daily.

In the above, five pounds corn-fodder were fed against one pound of hay, and the hay gave the best results; whereas we are told two or three pounds of corn-fodder ensilage are equivalent to one pound of hay. I have a mass of facts regarding corn-fodder, from which the corn has been harvested, fed in winter against hay. The elements of critical comparison do not exist between this corn-fodder and hay, and green fodder-corn and hay; yet the amount and character of the dry matter fed in either case, and the effects of either source in milk and butter product, when compared with the same standard of dry hay, make it certain to me that little, if any thing, is to be credited to corn-fodder, because green fed.

If it will be allowed as having an important indirect bearing on the subject, I may say that for four years I have yearly, to steers and cows, fed roots (green food) in winter. The weight of cows, milk-flow, butter-product, and hay eaten, have been taken for comparison with and without roots. The weight of steers, and the effect of a ration of roots added to hay on the amount of hay eaten, have been taken. Thousands of weighings may be summed up in the phrase, "A pound of green food in form of roots has been no more effective than in hay." The statement will bear being put a little stronger.

FERMENTATION MAKES FOOD DIGESTIBLE.

This is a claim by some admitted to a certain extent; but, as any fermentation that increases the digestibility of otherwise indigestible parts must be accompanied by loss, it is not worth pressing. The amount of indigestible matter found in one hundred pounds of green fodder-corn is four pounds; but a small fraction of this will be made available by fermentation. As covering the results of several trials that have come to my attention, I will quote the conclusions of a joint trial of U. Brewster and others: "Souring and fermenting cause a loss of raw material; boiling, scalding, and steaming diminish the digestibility by the large amount of water; steaming of hay diminishes digestion." It seems that the animal system has been arranged very happily to take care of its natural food, and that no system yet tried aids economically the animal digestive laboratory. Lactic acid is liable to be, and in fact is, formed largely in silos.

In German trials it was found that lactic acid exerted a solvent action on the bones of the sheep and goats, especially the younger ones. So far as I know, this fact may be more curious than useful; but it may be noted, that already two cases are reported where ensilage has nearly destroyed the cream-products. That an excess of acids may have some such effect has been noted with other foods.

WARM FOOD.

Ensilage is cut up and loosened over night: fermentation takes place, and warms it. This is claimed as an advantage. A moment's reflection will show that such heat is produced at the expense of the food itself, — by its destruction; and that it would be better to feed it cool, and allow the changes that warm it to transpire in the body, and so help warm the beast: for the formation of heat from food outside of the body is attended by loss of heat of the food by radiation into space, which is lost to the beast.

EXPERIENCE PROVES ITS ECONOMY.

1st, Many of the stories told are physical impossibilities. There are some in print, where the results claimed are such as to require more albuminoids than the food contained.

They would not deserve mention, were they not thoughtlessly allowed to influence opinion.

2d, Others have done in this way, — weighed their animals eating dry food at the time when they were thirsting. Eating ensilage they get all the water needed. The next weight is honestly taken, and found at the end of a month to give a gain of a pound a day, which may in reality be a loss. Thus I find that a steer of eight hundred to a thousand pounds' weight will drink fifty to sixty pounds of water a day. The first weight was without drink: the last, with drink; because, feeding on ensilage, they drink as they eat.

3d, It is said that ensilage costs but two dollars a ton, and that a cow consuming sixty pounds, and five pounds of cotton-seed meal, — costing in total thirteen cents and a half daily, — will do as well as on thirty pounds of good hay costing thirty cents, if not better. The fallacy of rating the hay at a handsome profit for raising, and ensilage at less than cost, ought to be apparent to all. A captivating fallacy can be met in no better way than by similar illogical reasoning. I published the cost of a sixteen-acre field of corn; and, rating the corn at thirty cents, the stover cost two dollars and eighty-five cents per ton.

As the result of weights for long periods, not only of fodder, but of cow and milk, a change from corn-fodder and straw and 2½ pounds each of corn and cotton-seed meals to hay was followed by decline of milk-flow. My cost of ration then was 22½ pounds stover and straw at $2.55 per ton, 3.2 cents; 2½ pounds of corn meal at 30 cents per bushel, 1.34 cents; and 2½ pounds cotton-seed meal at $30 per ton, 3.75 cents: total cost, 8.29 cents. If this is not fair comparison, will not some one point out the fallacy? Suppose we get up a little revolution in favor of rotations and air-dried crops? But, as none of us are working for cost, I presume that no one will get excited in the matter, and hence no caution from me will be necessary. I may say that I have seen results from most of the silos of the county for the years 1880 and 1881, and have seen no trial above criticism that is very favorable. Professor Cook of the New Jersey Experiment Station made an accurate trial, so far as it went, and is decidedly unfavorable to all claims made regarding the peculiar feeding-value of ensilage. Animals

fed, cows. First period, given 2.5 pounds proteine, .5 of a pound fat, and 12.5 pounds carbohydrates, each animal, and in digestible amounts.

Yield, lot 1. — 48.6 pounds milk.
2. — 49.7 pounds milk.

In the second period, 100 pounds of ensilage were given to lot 2, in place of 40 pounds turnips, before eaten; rations of each otherwise the same.

Yield, lot 1. — Second period, 51.3 pounds milk.
2. — Second period, 48.9 pounds milk.

The third period of five weeks, lot 1 was fed as before, and lot 2 fed 120 pounds ensilage, each cow, and 5 pounds cotton-seed meal. This furnished as much of each of the nutrients as lot 1 had. It was all eaten.

Yield, lot 1. — Third period, 48.4 pounds milk.
2. — Third period, 48.2 pounds milk.

Here are exact facts, and in agreement with just what scientific men have claimed; and yet careless observation will no doubt go right along laughing at science, and claiming all by guess. One well-taken fact is worth all the world's guessing. As I have ever been, without exception, engaged in economical farming, I may fairly take exceptions to the loose methods of arriving at results by those engaged in the same efforts.

Professor McBryde of the Tennessee University has gone through an elaborate set of experiments too full to admit of review. He fed ensilage alone, with the following result, for thirty days: —

Amount Fed per One Hundred Pounds Live Weight.	Weight of Steer.	Loss.
LBS.	LBS.	LBS.
40	825	20
50	965	8
60	900	25
20 (hay)	687	13 (gain)

A bad showing, and worse than I came out with by straw, and evidently worse than my results with stover alone, from

which corn was taken; for twenty-three pounds and a half per day made a gain of fifteen pounds and three-quarters in thirty-five days.

In the following experiments, grain and ensilage were apparently cheaper foods than hay and grain. I have already shown, that, with dry foods, straw, or stover and grain, were more economical than hay.

With McBryde, three steers gain fifty pounds and two-thirds each, in a month, with a feed of forty-eight pounds of ensilage and six pounds and a quarter each of cotton-seed and other meals. As no analysis of his ensilage is given, I can only guess, by the heavy loss in weight from his silo of the previous year, that it must have contained twenty per cent or more of organic matter; which would give nine pounds and eight-tenths in ensilage, and about five pounds and seven-tenths in grain, or a total of fifteen pounds and five-tenths each. My ration of organic matter for a gain of forty-one pounds and a quarter for a month contained fifteen pounds and two-tenths organic matter per day per thousand-pound steer; but it was fed in a colder climate. My stover, of course, had the richest part in the ear taken off; and the ration contained less than half the amount of grain, and gave a little less of gain. The elements of exact comparison are not here; yet a candid comparison of the results will show a difference, in the efficacy of the food, in favor of my ration. With oat-straw, my rations contain much less organic matter than those of McBryde's, or over twenty per cent less; and this straw is robbed of its richness by grain, threshed out, and supplemented by less than one-half the meal that the ensilage had. It is the

FOOD COMBINATION

that is giving to ensilage most of the credit that is said to belong to it, but erroneously credited to it. Ensilage and grain very likely are cheaper than hay, but are not probably so cheap foods as either stover, or straw and grain. They have given a misapplication to a valuable fact that they do not see, and credit to ensilage, as such, the glory that belongs to the union of two foods, and that might more easily be had, and valuable capital saved for farm improvements.

That ensilage may not have a place in our agriculture, I am not prepared to say, but judge that it will be a modest one. To those who will build only on high hopes, it is safe, I feel, to advise them to wait.

Mr. Philbrick. What kind of fish did you use in those experiments where you fed it to cattle?

Mr. Sanborn. I procured it in New York. It was ground fine, like meal. I suppose it was the refuse after the oil was pressed out, the same material from which the fertilizers are made.

Question. Could you raise enough dry fodder on one acre of the best land you ever saw to supply six cows a year?

Mr. Sanborn. It may be possible, but I do not think it is probable just yet. I should want to feed grain with it.

Mr. Paul. I want to ask whether you have fed fish and blood to swine.

Mr. Sanborn. I have fed it to some extent to swine.

Mr. Paul. In what way could it be prepared so that they would relish it?

Mr. Sanborn. All that has to be done, is simply to dry it, so that it will not ferment in the bag. This was dried, and ground fine, like meal, so that it would keep.

Mr. Lane. Do swine eat it readily?

Mr. Sanborn. The odor of it is offensive to them; but, by mixing a little with meal, you will in time get them to eat it. You do not want to feed it clear, because it is wasteful to feed it alone.

Mr. Grinnell. Do you really propose that we shall buy dried fish, and feed it? or do you state that as something that is possible?

Mr. Sanborn. My opinion is, that dried fish, at the price foods are selling for to-day, is a profitable food to purchase to feed with your coarse fodder. It has given me a profit for use, and left three-fourths its cost in manure-heap. If you have to buy food, you want to buy that which is cheapest, all things considered; and just now I should buy cotton-seed meal, which runs with me from thirty-eight to forty-five per cent of albuminoids. It is the most profitable food I can find to mix with my coarse fodders. It has usually been twenty-five dollars a ton by the carload.

Question. How high may it be and still be called a cheap food?

Mr. Sanborn. It depends upon the fluctuations of other products. Hay and other crops are higher than usual this year; cotton-seed meal rises and falls with the other things: and you want to keep that ratio. At twenty-five or thirty dollars a ton, I would rather buy it than any other material I know of. Fish is usually forty-five or fifty dollars a ton: I think I paid fifty for that I bought. I should prefer to buy cotton-seed now than to buy fish, although I should consider fish would be profitable food to put with coarse fodder. I may say, that, in those experiments that I made, there were tests of cotton-seed meal against oil-cake, bran, and other foods. The new-process oil-meal has given me the most unsatisfactory results.

Dr. Wakefield. Is there any difference as to the amount of labor required to get cattle to eat either cotton-seed meal or fish?

Mr. Sanborn. There is no great labor involved. You stir the fish up with a shovel in their meal until they learn to eat it, and then put in a little more, until you get them to eat all you desire.

Mr. Grinnell. How does the new-process oil-meal compare with other feeding-materials?

Mr. Sanborn. Theoretically it should be good food; practically, when I tried it, it did not give me so good a result as I got from cotton-seed meal. The result, on the whole, was unsatisfactory.

Mr. Grinnell. Do you know what the preparation is?

Mr. Sanborn. The oil has been extracted down to about three per cent.

Question. Do you consider it harmful to cattle?

Mr. Sanborn. No, sir. I fed mine for a term of one hundred days. The simple fact was, that they did not do so well when fed with that as they did with other combinations. They consumed nineteen pounds of straw and six pounds of oil-meal per pair, and they grew constantly during the period.

Question. You have, perhaps, convinced us that we should abandon the raising of hay-crops, and turn our attention to raising grain-crops. You have shown us how much

more can be done with an acre of corn, as compared with the results of the crop from an acre of grass; but you have said nothing about the relative cost of producing the two crops: does not that come in as an important element?

Mr. Sanborn. Certainly it does.

Question. Taking into account the labor, is there so much more advantage in raising grain-crops than hay-crops?

Mr. Sanborn. If we should go into the discussion of cost, there would be so many elements brought in that it would be interminable. To make a short statement, I will say, that, since I have changed my practice, the actual net revenue of the farm has been larger than at any time previous. The income is increasing each year with the increase of tillage.

Dr. Wakefield. Will you state to the audience what you consider the cheapest food to make the best butter?

Mr. Sanborn. I had some cows that were in lots of two, consuming about forty-five pounds of corn-fodder and straw mixed, and five pounds each cow of cotton-seed and corn meals. I put four cows upon hay without any grain, fifty pounds of hay costing thirty-seven and a half cents. The mixed food cost twenty-nine cents,—eight cents less; and the milk-flow, in exact figures, went down on the four cows ten per cent. I find the cheapest food for a good quality of butter is corn-fodder. The cheapest combination I can make to maintain a good quality of butter is corn-fodder, cotton-seed and corn meals. I give them a foddering of straw every day.

Dr. Wakefield. No hay?

Mr. Sanborn. Let me say that I always, when I have clover-hay, put in a foddering of clover-hay. I would never farm without clover-hay. I do not put in any English hay.

Recess until two o'clock P.M.

Afternoon Session.

The meeting was called to order at two o'clock by Capt. Moore.

The Chairman. The subject of the lecture this forenoon was "Animal Growth and Nutrition." An incidental subject closely connected with it is the silo. That subject

is now open for discussion. We would be glad to hear from any one who has had any practical experience, and who desires to speak upon the subject.

Mr. WARE. I would like to say a few words upon the subject of the lecture this forenoon. It is well known that for many years we have been discussing the subject of plant-food, and we have learned, that, to furnish suitable plant-food, we must have certain elements in proper proportions to meet the demands of the plant; and we have been led to inquire from that whether the same principles might not apply to the feeding of animals, for it is true that the principles which govern vegetable life are in a great measure applicable to animal life: therefore it is necessary to know how we can feed our cattle in the most economical manner to secure the results that we require. The lecture of the morning was upon that subject: and to me it was exceedingly interesting and valuable, because it came from one who, I understand, is a man of scientific attainments, who has been very careful in his experiments; and he has given us substantially the results of those experiments. That is what we are after. What we want to know is, How can we feed our animals in the most economical manner? and how shall we get the food in the cheapest and easiest way? The subject of the different kinds of food, and the mixtures of food, has been very carefully gone over; and the results seemed to be very satisfactory. He has indicated several sources of food, new to many of us; and no doubt they may prove very valuable suggestions. That is of great importance; and such a subject cannot be discussed, of course, without touching upon the subject of ensilage. That interests us exceedingly. Our hopes have been raised very high, and from time to time those hopes have been more or less disappointed. Last year Professor Goessmann, whose opinions we respect, gave it a blow that staggered me in my opinion of ensilage; for I must confess I had very high hopes of it: but afterwards, by further investigation, I learned that his statements last winter were based upon analyses made by German chemists about thirteen years ago of ensilage that was taken from silos built upon the old plan; that is, covered with earth, without any cutting up or any preparation. I have no doubt that ensilage from such a silo would indicate as great a loss as was stated

by Professor Goessmann. Such analyses are really worth nothing, unless they come to us in such shape that we can depend upon them as comparing the nutritive qualities of ensilage with the green fodder. I claim that instead of going backward, and adopting the old system or the old plan of ensilaging, where all this great loss has been proved to exist, we should go forward and onward, and adopt the best system of building silos, and the best method of making ensilage; and I believe, that, when we are able to present careful analyses of ensilage preserved in that manner, they will show very different results.

Now, I think it is right and just to consider all systems of producing fodder in a fair way. If we have a theory to set up, let us sustain it and establish it as well as we may; and, when we are discussing other theories and other methods, let us discuss them with fairness, that we may, as practical men, judge between the two systems. Now, it is unfair, in reckoning the cost of ensilage, to say that the expense is so great that no farmer can afford to use it. Why? Because, as was stated here this morning by the speaker, the cost of a silo that would hold one hundred tons would be four hundred and fifty dollars, and adding that to the cost of growing your crop and cutting it would make the cost of your ensilage very high. So it would: but, when you build a silo properly and substantially, you build it for all time; it is a permanent structure. You might with just as much propriety add to the cost of your English hay that you feed to your cows through the winter the cost of the barn that you have built to hold your cattle and your hay, as to add the cost of your silo to the cost of your ensilage for that year: therefore I say that position is unfair.

Again: in considering the statements, "the exaggerated statements" as they were called, concerning ensilage, I say it is unfair to take an instance (the only one that was mentioned) of a man who had fed his cow upon forty pounds of ensilage, and, I think, three pounds of cotton-seed meal, and obtained sixteen quarts of milk per day. The albuminoids contained in that milk would be more than would be contained in the ensilage and the cotton-seed meal, showing an absurdity. Of course, it was expected that the production of that quantity of milk would draw upon the flesh of the

animal, which no doubt it did. Now, why take that instance of forty pounds, when every man who has fed ensilage, and all the authorities who have written upon it, say that sixty pounds is the amount requisite to feed a cow, with a proportionate amount of cotton-seed meal? That would change the whole state of things entirely. We may say to ensilage and to the silo, "Down, down!" but it will not down. It has been too well and firmly established, not only in Europe, where it has been largely adopted (particularly in France), but in this country. In Massachusetts, in New Jersey, in New York, in Vermont, it has been tried thoroughly by our very best and most progressive farmers; and they all declare that it is a success. You cannot argue it down. You cannot put it down by bringing up an instance of one cow fed upon two-thirds of a fair feed per day, and making that the standard. I say such an argument is unfairly put, and the claims of ensilage cannot be met in any such way.

We want to learn how to feed our stock in the most economical manner. The advantages of dry food have been presented to us, and the advantages of green fodder. The growth of corn has been shown to us as being very great. I agree with every word of it. Corn-fodder has been proved time and again in this State, within a year, to be worth as much, pound for pound, as the best English hay, for the production of milk. That is a great revelation to the farming interests of Massachusetts, and a very important one. But we must consider the cost. We know that corn-fodder, well cured, well housed, and properly fed, will produce those results; but we also know how difficult it is to cure corn-fodder properly. I was going to say that it is impossible, and there are certain seasons when it certainly is; and there is a great deal of labor attending it also. The labor must be considered, in curing and preparing corn-fodder, just as much as the labor should be considered of carting twenty-three tons of water into the silo. The labor in the one case should be considered just as much as in the other in estimating the cost of the food. Professor Goessmann has told us, that, in drying hay without rain, there is really no loss of nutritive quality; but he says that two or three rains, such as we are apt to get upon our hay, will reduce the nutritive quality of that hay or fodder from twenty per cent to more than fifty, besides the

labor attending the curing of hay in rainy weather. The loss is not pretended to be any thing like that in the silo; so that, in estimating the value of dry food in comparison with green food, we must take all of these things into consideration in order to get at fair results.

Another point. It was stated that it had been claimed (and I suppose that referred to my statement) that forty tons of corn-fodder could be grown upon an acre; and another gentleman asked the question if it were possible to raise enough food upon an acre of ground to keep six cows a year. But it will be noticed that I did not say "a year:" I said "through the winter." I said that enough food could be grown on an acre to winter six cows. I said so then, and I say so now; and I say it is possible to grow forty tons of corn-fodder to the acre. We were recommended by the essayist to intensify our farming. He said that we should do that in order to secure the greatest profit. He quoted the cases of several farmers who had grown this year from fifteen to twenty tons per acre. This year has been a very bad year to grow ensilage: a great deal of corn failed to come up. It has not been a successful corn year. A great many farmers have grown not more than fifteen tons to the acre, and some not more than ten; but other farmers have grown forty tons and more. Intensify your farming. Get the greatest results from the smallest area of land. Cultivate highly, and you can get your forty tons and more, I have no doubt. So that, in discussing this subject, it is unfair to take the lower products instead of the possibility of the greater, that may be easily obtained from intensified agriculture.

The cost of the silo and of filling it was alluded to, and it was made to appear that it was more expensive food than dry fodder. Then the position taken by the advocates of the silo — that there was an advantage in ensilage over dry food — was not admitted. But I believe that it will not be necessary to make a very extended argument to prove that green grass in June will produce more milk, or more flesh, than the same grass cured and dried into what we call rowen-hay, and fed to the same animals. Professor Goessmann says there is no loss of nutriment in the drying. You may let a cow, or any animal, feed on this green succulent grass, and then let them eat the same grass when cured and made into

hay, and is there a practical farmer here who will not admit that there will be greater results from the green grass than from the same grass cured into rowen-hay? I believe that chemistry as applied to agriculture has done a great deal for it, and I honor it, and heed the results that have been given to us; but I do believe that there is something in the principle of life that is exhibited in the green grass that cannot be analyzed — that cannot be reached by any chemical analysis that we have at our command. We cannot measure the value of it as applied to the animal system. That I believe; and I think your experience as practical men will sustain me in that belief. So that, when we hear of the analysis of the different materials of the green grass as com pared with the dried food, there is something that I call, if you please, the spirit of life in that green grass that has not been reached by that analysis; and I think it will explain in many instances the discrepancies that appear between the investigations and the analyses of the scientists and the practical results that we see every day.

Now, I claim, in advocating the silo and ensilage, that we do preserve, to a certain extent (I do not know how much or how little, but to a certain extent), that principle and spirit of life that I have been speaking of. I know of a great many instances of farmers who have changed the food of their cows from ensilage to hay, and I do not know of a single instance where the cows did not shrink in their milk after that change. Then, after feeding hay a while (and, mind you, they were given the same quantity of grain in both cases), they were changed back again from the hay to the ensilage, and they increased in the quantity of milk; and this milk was not obtained at the expense of their flesh. They still maintained their flesh, and increased the production of milk also. So that, as far as I am concerned, if every analysis that has ever yet been made tends to prove that there is such a great loss in the process of ensilaging as to make it useless, if my cows will come forward and say, in the products at the pail, and by the touch of the hand, that they are increasing the quantity of milk, that their flesh is increasing, that their skin is soft and pliable, that their hair lies smooth, and they look healthy, I will go with the cows every time.

But I do not wish to have it understood that I am denouncing the results of these chemical analyses. I approve of them by all manner of means; and we want all we can get. But chemistry has not yet attained to its highest development in my opinion: and in order to obtain the best results, that we must have in order to have a certainty, we must have something else besides the chemical laboratory; we must have the laboratory of the animal stomach to investigate, and we want that done under the eye and care of these very scientific investigators. The only way to obtain that, that I know of, is by the establishment of an experiment station, where those experiments can be pursued in a scientific manner: not under the general observation of farmers, which was so strongly denounced here this forenoon, and rightly, it may be, for we do make great mistakes; and we go groping in darkness, without this very accurate knowledge that may be obtained at an experiment station, under the eye and care of scientific investigators. We, as farmers, cannot do it: we have not the ability to do it. We can only go on in our way without this help, and judge from the results at our milk-pail and at the slaughter-house. But we want to know more — we want to know, as the gentleman said this forenoon, before we come to that point, just what material to obtain in order to bring about these results in the most economical manner.

Now, I suppose there are some gentlemen here who feel that I have got ensilage on the brain, or, as one gentleman has expressed it, that I am a "crank" on that subject. I am; but I tell you I have no axe to grind: I only want to know how to feed my cattle in the best way; and, when I find it, I am very glad to tell my neighbors all I know about it, — I am very glad to inform them of all my experiments; and now, when I have a silo built in a substantial manner, and have about one hundred tons of ensilage in it, I think I shall try to feed out that ensilage; and if next spring I find I have made a total failure, depend upon it, I will let you know. I will not keep it from you, if I find I have made a mistake: I will own up, back down, ask your pardon, and do every thing I can to redeem any mischief that I may have committed.

Mr. Sanborn. I have been very much interested in the remarks of the gentleman. I have been taking some notes

of his eloquent, but, I must say, rather sophistical address. I think he has treated the subject as it was left very skilfully indeed. He has ignored very much that was said with a great deal of art. I have no suspicion that our friend is a "crank" upon the subject of ensilage: I have a slight one, however, that he is an enthusiast. I hope he will realize his sanguine expectations. I suppose that he must have slipped out of the back door when I got about half way through, by the way he uses the facts that I stated this forenoon. In fact, he has gone upon the good old-fashioned idea of brushing away exact statistical facts by a sweeping general observation. I am not aware that he has specified a single fact to offset one assertion I made this morning. Always a farmer myself, and always farming a farm of my own, I am always careful not to make any general proposition that must rest heavily upon mere theoretical deductions, and that I cannot base upon facts taken. I think, Mr. Chairman, that I have less respect for chemistry as applied to nutrition than the gentleman claims for himself; for such observations as I have made for a number of years, of cattle feeding on the farm, lead me to believe, with the gentleman, that chemistry is not yet competent to fix the value of food accurately. I believe it would be very useful, if we were buying a given food, that we should buy it upon the basis of chemical analysis; but I should not expect that chemical analysis to measure with accuracy the value of that food in nutrition, or its value as compared with what an analysis might show some other food to contain. We have still need of a great deal of skill in determining the value of food after we have bought it upon analysis; yet a chemical analysis might be, in its proper place, a vast deal of use. There are various changes going on in the maturing plant, whose significance is not known: there are many things which the chemist, or animal physiologist, cannot as yet find out in regard to the functions in feeding of animals of the constituents of food; so that, upon that subject, I am fully as radical as the gentleman himself.

I think some of you may have been misled by the gentleman's misapplication of the terms that I used this morning. He uses the word "unfair." I think he made a very unfair use of my talk this morning. He says I spoke of feeding

forty pounds of ensilage a day, and took that as the standard, and four quarts of bran. I distinctly said, when I first spoke of that amount, that I used it for the purpose of showing some of the fallacies that had been propounded. I afterwards used sixty pounds of ensilage and five pounds of meal as the amount generally claimed as used by those feeding ensilage, and said, that, in my experiments, I had fed with equal success less organic matter in dry foods. In illustrating this point, I said that Professor McCook, in actual experiment, fed a given number of pounds of dry matter in this very same ensilage, which amounted to eighteen pounds and three-tenths digestible nutrients against the same amount in air-dry foods, and the air-dry foods came out ahead. In my feeding-rations that I named to you, I used two pounds less of digestible matter, and got as much milk as he records, — twenty-three quarts per cow. Now, there is an exact fact. That is not a general observation; that is not guess-work. There is this honest cow behind it, that cannot tell a lie, you know. She is behind all these statements. Now, if the gentleman will give me one single absolute fact, verified by his own experience or that of others, that is contradictory of this, I shall be glad to hear it. I have also quoted Professor McBryde's experiments with ensilage, where he weighed every thing, and had an honest steer behind it. He used more organic matter in the ensilage than I did. Further than that, I do not think that Professor McBryde took out of the silo all the dry matter he put in. He supposed there was a loss; but I assumed that every thing came out of the silo that he put into it. I also remarked that fifteen tons to the acre was this year's product. I said that was the amount the farmers were getting; but afterwards I stated that twenty-five tons was the standard. I do not believe that the average result of New-England farming is twenty-five tons. I asked an intelligent and thrifty farmer in the river-valley, who has one of the most fertile farms in New England, how much he raised, and he said twenty tons. "Do you think," I said, "that is as large a crop as would be raised on land capable of producing fifty bushels of corn to the acre?" — "Yes, sir, as large as would be raised on an average farm. I can as easily raise sixty bushels of corn as I can twenty-five tons of corn-fodder." And my own experience tells me that twenty-

five tons of corn-fodder is a good crop. That was the standard I used, not fifteen. There the gentleman would place me wrong before you.

Mr. Ware. Excuse me. I said fifteen or twenty.

Mr. Sanborn. I did state that that was the amount raised this year; but at the same time I preferred to use as the standard twenty-five tons in order to meet any criticism that might come from such arguments; and I also said that Mr. Cheever had raised as much dry matter from millet this year, per acre, as is raised in twenty-five tons corn-fodder. I maintain that these results show accurately that dry food is substantially or fully as valuable as green food. Furthermore, I did say that I had fed from eighty to a hundred pounds of corn-fodder, for three separate years, to cows against hay, the exact weights of milk being taken (and they say that two pounds of ensilage are equal to one pound of hay); and yet, in that exact experiment, carried on for three years, that quantity of corn-fodder, varying from eighty to a hundred pounds, even the hundred pounds, did not make so much milk as twenty pounds of hay. That is definite and decisive, and right to the point, it seems to me. I found, as regards superiority of green crops, the same result also from the root-crops. There is no scientist behind all that. I am not a scientist: I am engaged in practical farming. That is all I have to say on these points.

Now, I am not talking as an attorney or advocate. I have no interest one way or the other. I farm a very large farm; and there are very few farmers in New England who have more at stake than I have personally. I do not believe there is a farmer in New England who would be more glad to see the enthusiastic predictions of the believers in ensilage fully realized than myself. Indeed, it was with the deepest regret that I found that this new revelation was not to fulfil the expectations of those who so warmly preached it. We have got to meet stern facts. A few years ago steaming food was going to revolutionize our whole system of farming; and yet a gentleman who had a very extensive herd of cows told me that he had met with various difficulties in consequence of the use of steamed food. So, too, of muck. There was a time when it was supposed that every farmer who had a muck-bed could make himself rich. It was thought that

every muck-bed was a mine of wealth, and would make a man rich at a bound. But where is muck now, after twenty or thirty years? I am not here to denounce muck: it has its place, but it is not going to revolutionize farming. The silo has its place, in a very modest way; but it is not going to make you all wealthy. I believe in corn as strongly as any ensilagist in the country, but a silo is not necessary to grow it. You can grow it, and, I believe, feed more cattle from an acre of corn matured than you can from an acre of ensilage. If you look at the science of it, you will find that the chemists have discovered that the nitrogen of the plant has not been organized into flesh-formers at the time you cut it for ensilaging. I cut my hay after bloom; though I was, previous to experimenting, an ardent advocate of cutting as it went into bloom. I had to change my opinion after ten different experiments. Now, the scientists tell us that at the time of bloom the plant contains nitrogen not organized as albuminoids, and it is only as albuminoids that you can use it to make flesh: that is to say, the plant is not fully organized as food at the time of bloom. After collecting from personal work and the work of others all the facts I can, I do not believe that its development afterwards will decrease its nutritive value. Mere reasoning will not settle the problem, but facts seem to corroborate this view. We know that plants have not completed their growth at that time. I find grass increases from thirty to forty per cent from early bloom to full formation of seed. Now, your corn-fodder, as it is grown thick, cut at that early period, has some materials in the sap not organized into plant-tissue, which will never have the food-value that they would have if the corn were allowed to mature. That, I submit, is a valid objection to this innovation; it favoring a crop so thickly grown as to fail to mature, and yet yielding no more dry matter per acre than matured field-corn.

I did not intimate for a moment this morning that the cost of the silo should be charged to the first crop, as the gentleman makes me say. I did say that he himself, and two other gentlemen, had said that their silos cost them three dollars for every ton of capacity. Now, if you grow twenty-five tons of corn-fodder, that is seventy-five dollars

for your silo. The interest on that, at six per cent, is four dollars and fifty cents. That is a fact to begin with. I submit that it is a valid objection, — one that cannot be lightly brushed aside, or passed over. We may go contrary to mathematics, but it is an exact science. We may defy it, if we please; but we know who has got to suffer when he butts his head against a wall. It is the interest on that every year that is the cost. If a man grows fifty acres of corn-fodder, his silo will cost him, at that rate, thirty-seven hundred and fifty dollars, — as much, perhaps, as his farm is worth.

As I have said, I am not here as an advocate. I want simply to state facts. We must look facts square in the face, and not be carried away by a momentary excitement. It takes a good deal of a man to keep cool when the tide is rushing in one direction; and I think that a good many of our farmers are level-headed men, for I find that they are keeping cool. In saying this, I do not say that the silo should be kicked unceremoniously out of New England. I say it should be brought down from the elevation to which it has been hoisted in public estimation.

Mr. Slade. I wish the gentleman would answer one question before he takes his seat. Suppose you were put in possession of ten cows, and were required to supply this village with milk to the greatest extent possible, and you had nothing to feed them on, and had to go into the market and purchase the food, what would you purchase, and how would you feed it to produce the most milk?

Mr. Sanborn. I will suppose that hay is twenty-five dollars a ton, oat-straw eight dollars a ton by the carload, and corn-fodder eight dollars a ton, — said to be the prices of this place. If I had the hay and fodder in my barn, I should sell the hay, and use oat-straw and corn-fodder. I should not use the hay. I should buy limited amounts of clover, if I could (as often can be done for less than hay), because it is worth half as much more than hay as a fertilizer. I would feed the straw and the corn-fodder (more of the latter), with the addition of some cotton-seed meal. Taking the coarse foods I have named as the basis, I should put with them cotton-seed meal, bran, or corn-meal. I do not believe in feeding for a poor quality of milk.

Mr. Slade. Would you buy what we call shorts?

Mr. Sanborn. Yes, sir. Very many suppose that milch cows should be fed radically different for milk from what they would be for butter. I sell milk. I feed substantially the same for milk that I would for butter; because I do not believe it pays the farmer himself to make poor milk, for the reason that the vitality of the cow has got to be supported. If your food will make poor milk, it will be bad for the vitality of the cow, and in the end you will be the loser. I have not very much faith in the green foods: I do not think they increase the flow of milk to any great extent.

Mr. Slade. What quantity of meal would you feed?

Mr. Sanborn. That is a matter of opinion. I feed six pounds a day of the mixture.

Mr. Slade. Are shorts injurious to the quality of butter?

Mr. Sanborn. Yes, sir. I can feed six pounds of corn-meal to advantage; and six pounds of corn-meal will increase the butter-product seventeen to twenty per cent over bran, and give a better quality also.

Mr. Slade. Will it increase the milk over shorts?

Mr. Sanborn. No very great difference. The corn-meal will give about one per cent more of milk than the bran.

Question. You speak of the use of cotton-seed meal: what is the cost of it at the present time?

Mr. Sanborn. I pay thirty-one dollars a ton by the car-load. I speak of cotton-seed meal for the reason, as I said this morning, that I think it is the cheapest food that I can buy.

Question. Do you think there is any danger in feeding cotton-seed meal?

Mr. Sanborn. Yes, sir, if you feed too much of it. I have had trouble in feeding too much. I lost a pig this summer by feeding an excess of it. I have fed an excess of it to my steers, so that I had difficulty in getting them out of the trouble. I never feed a calf a few days old with it. I wait until it is a few weeks old, and its stomach gets strong; then I begin with a small quantity. I never care to feed a steer more than three or four pounds a day for growth. I may say, further, that there is no need of it. It is very rich in albuminoids, and you do not need to feed six pounds: if you do, you waste part of it. Three pounds is the limit of

desirableness. If it is not the limit of safety, it is the limit of desirableness.

QUESTION. What is the nature of your trouble with steers?

Mr. SANBORN. They are made costive.

QUESTION. Do you suppose that it will produce garget?

Mr. SANBORN. An excessive amount of it would be dangerous. I have never had any trouble with garget. I know that corn-meal and cotton-seed meal are both said to produce garget, but I never have had any trouble. I think it is because I feed them with coarse foods. I do not feed them with hay. I have not fed bran with corn-meal for two or three years, to any extent, for the reason that cotton-seed meal has been cheaper. I would not feed bran for butter, in any event, or only in very small quantities.

Mr. CAPEN. I have seen it stated in agricultural papers, that there is a growing demand in Europe for cotton-seed meal; and the price is rising, and there is a growing demand here evidently. What substitute can be looked for in case it should rise to fifty dollars a ton?

Mr. SANBORN. In the first place, the supply at the South has never been touched, and it will be enormous by and by. But if you get short, I should recommend the use of clover-hay. I have this year about fifty tons of clover-hay which I have raised. When I am feeding clover-hay with my coarse fodders, I do not need so much cotton-seed meal. In fact, clover-hay and straw are all you want for ordinary growth: that will give you a pound to a pound and a half growth a day.

Mr. CAPEN. Your opinion of clover is very high.

Mr. SANBORN. Very high indeed.

QUESTION. What is the best way of feeding it?

Mr. SANBORN. I always feed it with coarse fodders. I should not value it so highly, fed alone. My cattle eat it up clean.

QUESTION. Did you ever give a horse any cotton-seed meal?

Mr. SANBORN. I never have. I have a pair of very fine horses, and the man who takes care of them has a great deal of pride in them. He feeds them hay, and I have never insisted upon his feeding them in any other way. But if I

were feeding them myself, I should give them cotton-seed meal and other grains, and some straw. I should not think of feeding a horse on hay alone.

QUESTION. Do corn-stalks cured in the ordinary manner (by stacking out in the field) lose much of their value?

Mr. SANBORN. I do not think they suffer any serious loss. I do not think I have met with any loss this year to be mentioned.

QUESTION. How would you feed dry cows and young stock?

Mr. SANBORN. I should feed young stock, as I said, on the coarse fodders and cotton-seed and corn-meal mixed. If I had to buy all my grain, I should feed the common animals three pounds of cotton-seed meal a day, and all the coarse fodder they would eat. You cannot grow young animals on good hay profitably in most parts of New England: it is out of the question, at present prices. I can give you some statistics on that point. I had two heifers that were fed on half cotton-seed and half corn meal: the rest of their food was corn-fodder and straw. They were yearlings, and weighed about seven hundred pounds. The cost per day was seventeen cents and three-quarters for the pair, — less than nine cents a day. The growth was three pounds and a fraction a day, — five cents and two-tenths per pound of growth. But my young stock gain in summer almost identically the same as in winter, — summer cost a cent and a half per pound, or average cost three cents and thirty-five hundredths per pound. These cheap foods I speak of make my steers and heifers grow as rapidly in winter as in summer. A year's growth costs a little less than the selling-value.

Mr. SLADE. When you speak of corn-meal, do you mean that the cob is ground with the corn?

Mr. SANBORN. I do: yes, sir. I find that a pound of it, particularly when fed to pigs, does just as much, or about as much good as clear meal. I would not feed it to very young pigs: they want something more easily digestible than the cob. I prefer feeding young pigs middlings. I have found that a pound of cob-meal gives me almost identically the same result as clear meal for pigs.

QUESTION. Does cob-meal increase the butter-product?

Mr. SANBORN. I have found that cob-meal does not in-

crease the butter-product any, and the milk but very slightly. Its value depends wholly upon where you use it. There is where the chemist cannot help you. The fact is, that, by experiment stations, you have got to get exact knowledge, and then you will get more and more light upon which you can work. We want theories to set the investigator at work to get facts, but the facts must come before we can formulate the law.

QUESTION. How do you get your cattle to eat up dry corn-stalks clean?

Mr. SANBORN. I don't. They will leave, perhaps, twenty per cent when they are fed with corn-fodder alone; but where I feed, as I am now feeding my cows for instance, a ration of clover-hay, a ration of straw, and a ration of corn-fodder, they eat up substantially the whole of the corn-fodder; but there is a little left, — sixteen per cent.

Mr. MERRICK. The figures show that it costs about a dollar a ton to cut the corn, and put it in the silo. What does it cost to cure your corn in the ordinary manner, get it into the barn, and, when it comes time to feed it, cut it up?

Mr. SANBORN. I do not cut it.

Mr. MERRICK. Does not the cost of curing it and getting it into the barn, and the amount of waste (twenty per cent), make a greater sum than the one dollar that it takes to put corn-fodder into the silo?

Mr. SANBORN. I have made some estimates upon that matter for myself. I do not think it does. I think the balance is on the right side.

Mr. ——. How much?

Mr. SANBORN. I cannot say; perhaps fifteen or twenty per cent. It is not a large matter, but the orts are worth about half the value for bedding. I charge them to the stock at three dollars for bedding. That is credited to bedding, and the remainder I charge to the animal. In the first place, there is one point worth observing in the growth of your corn, — most of the artificial supply of plant-nutrition that it takes to grow and mature a crop of corn — the potash, etc. — is found in the corn-stalks. Corn-meal is quite carbonaceous; and you will find that half or two-thirds of the plant-nutrition is in the corn-fodder itself; and there will be left in the orts, for plant-food, not, perhaps, what I charge to it, but

a great deal of what I charge to it; and then it still has another value as an absorbent under the cattle, and it makes a clean bed to lie upon. So that I think I charge less than I might be entitled to charge in that way.

QUESTION. If you should cut up your corn-fodder fine, and put Indian meal with it, so that they would eat it all, would it be good for any thing?

Mr. SANBORN. If they ate it, it would be of some value; but the part they do not eat is of the least value. The stalk is not so valuable at the bottom as at the top. It is not all eaten up when it comes out of the silo. I have seen ensilage where it was not all eaten up. I went to one place where it was claimed that it was all eaten up clean, and saw that there was considerable left. The man claimed that it was injured, and I presume it was.

QUESTION. Mr. Ware quoted Professor Goessmann as saying that English hay, if it were wet two or three times, lost fifty per cent. Now, in drying our corn-fodder, it will usually stand out from twenty to thirty days before it will get sufficiently dry to put in the barn; and in that time it will receive several rains, sometimes hard ones. Will not that corn-fodder lose quite a percentage of its nutritive value?

Mr. SANBORN. There are several things to be said about that. The corn-stalks do not get wet, except on the outside. The water runs down on the outside of the stack: it does not soak into it very thoroughly; and, when the water evaporates, it does not carry with it any organic matter. Again: fifty per cent must be an extraordinary loss; for I was reading very recently an account of a German experiment, where hay was allowed to stand two weeks through an almost continual rain, and the loss was inside of thirty per cent. It was put out on purpose, and allowed to be drenched through by a continuous rain of two weeks (I think that was the time); and the result was, it lost only about twenty-seven per cent.

QUESTION. Does it not make a difference whether the hay is late cut or early cut?

Mr. SANBORN. Yes, sir. If the hay is later cut, it will lose less. It grows less in green weight as the plant matures. The sap, in the process of transition in the stalk, carries with it the nutrition which is taken up in the seed and organized in the plant. Theoretically, I say, it will lose less ten days after blooming than two or three days before blooming.

Mr. Slade. Is not early-cut hay more palatable than late-cut hay?

Mr. Sanborn. Yes, sir.

Mr. Ware. There is one point which I would like to have explained, if you please. You have said, that after the time when corn is usually cut for ensilage, which is when the kernel is just about mature enough for boiling, there is considerable growth of material, and increase of nutrition: none of us would doubt that. But the point I want to come at is, whether the additional growth that occurs after the time when it would be naturally cut for ensilage does not draw more largely on the fertility of the soil to make that growth than the portion that is grown previous to that period; that is, in maturing the seed, does it not draw more largely from the fertility of the soil than it does up to that time?

Mr. Sanborn. I think I will convince the gentleman that it does not. The plant will have more of the albuminoids, so called, at the time of flowering; that is, it will have a greater percentage than at the time of complete maturity. The element that costs the farmer the most to supply to his land is nitrogen. The albuminoids have nitrogen in them: they do not increase so fast after flowering as before. The carbohydrates do increase rapidly, the materials of which come from the air and water. Therefore the growth between bloom and maturity is made relatively more from the air than from the soil. Then again, in practice, if it did, I should care nothing about it, because our purpose is to take from the soil all that is possible. We very often speak of cropping the soil, not exhausting it. My purpose in farming would be to exhaust the soil as rapidly as possible. If I could take off all there was in the soil in one crop, I should be very happy to; and I would put back as much as I had taken off the next year.

Mr. Slade. A gentleman says, "I have been raising fodder-corn, cutting it at a certain period, and feeding it. Why should I not let it stand and mature, and, after it has glazed, cut it up and stack it, and then store it? I would get clear of husking, which is very expensive, and get clear of many other items of expense." How would that do?

Mr. Sanborn. That question has received considerable attention. The great trouble is, that, as you very well know,

corn whole is liable to pass the system undigested. Experiments at the Maine Agricultural College with the hog have shown that a hundred pounds of whole corn is not as efficacious as a hundred pounds of corn-meal. I think the difference just about paid the miller. The cost of husking, going to mill, and toll, would be, for a good acre, ten dollars. If the whole corn-plant was fed in proper combinations with other foods, and pigs followed the stock, I am inclined to think the practice would be economical. Some one has adopted the practice of running the stalk with unhusked corn through rollers to crush the seed, and thus feed it, and reports great satisfaction.

Mr. PHILBRICK. I should like to ask one question, and that is with regard to the value of the corn-crop. If it is more valuable for feeding dry when it has matured, why would it not be more valuable for putting into the silo when it has matured? Why is it that we are obliged to cut corn for the silo just at the point when it begins to glaze?

Mr. SANBORN. Mr. Cheever said yesterday (and you know he has had great experience with forage plants) that he had come to the conclusion that he had better sow his forage crops so thinly that they would mature, and then feed them out. That bears very directly upon this question. Now, we need not plant our corn so thickly that it will not mature. Why not plant it thin enough so that it will? I am inclined to think that is the better way. That is my opinion.

Mr. ——. Then you would not get twenty-five tons to the acre.

Mr. SANBORN. You will get as much of the dry matter. I think that is the better way. You will have less to handle in the silo. As your crop matures, it grows less in green weight, but the dry matter is heavier: therefore, if you allowed it to mature, you would save handling so much weight. There might be a question of its keeping as well.

Mr. HERSEY. I have had my mind made up as to what I had better do myself; and that is, to plant corn, let it get ripe, harvest it, feed the corn and the fodder to the cows, and, if there is a surplus, raise pork and sell it. I have felt that by so doing I should be sure of not having to pay out money. If I build a silo, I reason in this way: I have got to pay out several hundred dollars to start with, and then,

after I have harvested my corn, I have got to pay out money again for cotton-seed meal. If I do the other way, I feel as though I am doing a little safer business, because I am having money coming in instead of going out. That is the point with me. Other farmers who can pay out large sums of money just as well as not, and who get their incomes at a season of the year when I have but little coming in, and who get them from some other source besides the farm, can afford, perhaps, to have silos. If the time comes when those who can well afford these experiments (for I consider that they are experiments yet) can prove to the satisfaction of everybody that they are getting rich out of it, I have no doubt that we poor fellows will follow them; but it will be only a question of time. We shall lose a few years of enormous profits, perhaps; but still, if I pay my way, and am happy all the time, I think that is the great thing. It seems to me, that, if I had to go and hire four or five hundred dollars to build a silo, I should begin to be a little uneasy. There would not be an absolute certainty of that four or five hundred dollars coming back again; and I do not know as I should sleep quite as well as I should if I felt that my corn was growing, and I was going to harvest it in the old way, and knew just about how much work it was going to be, and just about what it would do for my cows when I fed it out. Again: if I had valuable cows that I did not feel as though I could afford to experiment with, or fine horses, it seems to me that I should not feel quite as safe to feed them with a fodder that I knew nothing about, and with which we in this country have had but little experience. I should feel, as I went into the barn and looked over the cows and the horses, that possibly they might come out as I have been told Mr. Bailey's sheep came out last winter. I do not know as it is so; but I have understood that he lost a good many of his sheep that were fed on ensilage. We have yet to demonstrate, beyond the possibility of a doubt, that this food is not only cheap, but also that it is a food which is good for the health of our animals. You know, many of you, that the steaming-process had its day. It was considered a great discovery, and for a long while men fed it without any trouble. I know a man to-day who feeds fifty good cows, that are worth a good deal of money, on steamed food. He has fed

them for the last eight years in that way. I have endeavored to convince that man that there is danger in it. It has been found that it is not wholesome to feed animals on steamed food; but that was not found out in a week, nor in a month, nor in a year. We must wait to find out these things; and therefore I say I am going to be cautious about the use of ensilage. I am going to wait and see what the result is, and those of you who are of my mind of course will do the same. When I come before the farmers of Massachusetts, I feel that it is my duty to express to them my honest convictions. I feel that it is my duty, if I give them any advice, to give them the same advice that I will take myself.

Now, my friend Mr. Ware, a man to whom I always look up in many things for advice, it seems to me, with all his wit, is getting a little enthusiastic. You could all see how he felt about his horses. He tried to have us understand, that, when he fed his horses on a material that was eighty-seven per cent water, he could hardly hold them. But how long has he fed them? He has fed them about a week or two on that material. You can see at once he is getting a little enthusiastic, and I am afraid he is trying to get us so too. But let us be cautious.

Mr. Ware. After my friend Hersey has referred to me so pleasantly, I certainly should be ungrateful if I did not reply in the same way; but I am going to discuss the point in seriousness. The cost of silos has been the great bugbear from the beginning. Let me tell you, my friends, that the cost of building a silo is not such a formidable thing. In counting the cost of any thing, I never reckon my own labor, and I believe farmers generally do not. You may think that my labor is not worth much; but I tell you that I have labored with my hands all my life-time, and, in my earlier years, I think it is safe to say that I did the work of two men in the field every day, so that I know what real labor is. I am not in the habit of reckoning my labor very much in estimating the cost of any thing. I hire men, and that labor has to be paid for. Last winter I commenced with my two men that I hire by the year (in the summer I hire more), and at odd jobs, as a woman would take up her knitting-work, I went to work with my men digging a hole

for the silo; and I did not feel that the cost of building my silo was money paid out, except what I paid for the cement. So that it is not such a formidable thing to build a silo. A good farmer of common sense, like my brother Hersey, with one or two men, can do all the work, without calling in any other outside help — do it at odd jobs through the winter, when, as Mr. Russell said last night at the banquet, farmers were rather in the habit, now that machinery was so abundant and so perfectly adapted to the work of the farm, of hibernating, like the bear and the woodchuck. Instead of doing that, let him go to work and build a silo, and work in his farm help as he can, and he will get a silo without feeling the cost scarcely at all. The cement is all that he will have to pay for in cash. It is not a formidable thing to build a silo; and it is a thing which a farmer, with his ordinary farm help, can accomplish with very little money paid out. Now, that is my own experience. I was asked here last night what was the cost of my silo; and I stated what would be the cost, supposing I hired every thing done.

Now, Mr. Hersey says that to be happy is the great thing to be desired. That is what I have been trying to get at all my lifetime; and I can tell you that I never was really happy in seeing my cattle feed, until I built my silo. It has made me terribly unhappy to go into the barn and see them eating hay that was worth twenty-five dollars a ton, and realize that by spring they would have eaten off their heads. That has worried me, and made me feel unhappy. But I tell you, since I have been feeding ensilage, when I go in and see my cows, as I do two or three times a day (which has not been my practice), I am a happy man. I rejoice to go in there and see them eating that ensilage that has cost me little or nothing. They are thriving, and they are happier than I am. It is a meeting of mutual admiration; and, if that is not a happy meeting, I don't know what is.

I am not going into any further particulars. I think you have got my ideas pretty clearly. But I did want to bring before you how easily a silo can be built by a farmer of limited means without laying out much money.

Mr. Slade. How far from your barn or place of feeding is your silo?

Mr. Ware. The barn where I keep my cattle is in one

building. In an adjoining building, and attached to it, is another barn, which I use for a carriage-house. Under that carriage-house I had a root-cellar. I have been in the habit heretofore of raising roots, and feeding them to my cattle; and I had a good root-cellar stoned up eight feet deep. I dug one-half of that cellar eight feet deeper. The earth was hard-pan, sufficiently strong and tenacious to support the walls with the burden placed upon them by digging eight feet deeper. In digging that cellar, I found stones enough in the gravel, which I threw one side, suitable to be used in making concrete, as I call it; and in that same cellar was gravel just suitable to mix with cement; and, when I got down to the bottom, I struck a spring of water: so that I had all the materials there, except the cement, with which to go on and build the walls of the silo. The gravel that I carted out I needed to make roads with. It was worth all that it cost to dig it out for use on roads. So you see I got paid for digging out the gravel by the gravel itself. I would be glad to dig out anybody's silo, where there was gravel, if I could have the gravel; and the stones I found in the gravel were sufficient to use in the wall. The gravel that was there was just the right material to mix with cement, and I found the water in the bottom to mix it with. So you see, that, no matter how hard it stormed, I and my men could go in there, and build up that silo.

Now, since I have built the silo, I have removed my cows from the barn-floor to the basement. It is not a barn-cellar, because it is above ground, but it is a basement. I have an airy, well-lighted room in this basement. I have a little railway from where my cows are to the silo (which is thirty feet off), and a truck; and on it is a box that I fill from the silo, and then roll along on this truck on the railway in front of the cows, and feed it out to them.

Mr. Slade. Is the top of the silo on a level with the floor on which the cows feed?

Mr. Ware. No, sir. The top of the silo is on a level with the sill of the barn. The cows are in the basement, which brings them six feet below the sill of the barn. You remember I said I only used one-half of the barn-cellar for the silo. I left a door opening into the other half, which makes a level from the bottom of that door about half way

down the depth of the silo; so that half of the ensilage, provided the silo is full, is on a level with where my cows are: the other half, of course, would be so much below. So that the method of feeding the ensilage is very much more economical, and easier, than my former way; and I do insist upon it that the cost of feeding my cows is a mere trifle. I stated last night, that last summer I paid three hundred dollars for hay, not to feed my stock with, but to use on my premises. This year, my hay that I cut on the farm lies in my barn. I shall have the whole of that hay for my use next summer. I may as well tell you how I shall use it. I board some twenty-five horses in the summer, and of course they eat a great deal of hay. The hay that I cut on my farm I shall have for feeding those horses. The ensilage that I have I am feeding to my stock through the winter, and saving my hay. So, instead of paying out money, which Mr. Hersey dreads so much, I shall save all that.

Mr. Hersey. Are you not a good deal like the man who said he should have caught three rats after he had caught the one he was after and two more?

Mr. Ware. I say I have the hay. Now I will give the floor to Brother Hersey.

Mr. Hersey. I really want to thank my Brother Ware for the information he has given us; and it is important. It is something that I really never thought much about, that we should work for nothing. I pretend to be expert in the rock business, carpentering, etc., so I can build a silo for nothing. It will not cost me any thing: so that bugbear is gone. But let me tell you it has given me great happiness in another direction. Now I can go into the barn, and see my cows feeding at no cost at all. They are eating corn that I have raised with my own hands, as he has built his silo. I have not paid two laborers: I did the whole work myself. Therefore I can go in every morning, and see them eating food that has not cost me any thing; and I am going next year to do still more.

Mr. Capen. I think there is no one in the audience who will doubt that it is always safest to learn to swim before going into the water. Brother Hersey has done that in regard to silos.

Mr. Slade was called upon; and that gentleman came to

the platform, and said, "Ladies and gentlemen, I now have the pleasure of introducing to you Capt. MOORE of Concord, who will address you on fruit-culture."

Capt. MOORE. Ladies and gentlemen, I have always been abused in this way. I never sat down in a good comfortable seat that somebody did not rout me out of it. I think that you have not discussed this subject enough; and Mr. Slade, who has investigated it, ought to talk to you about it. I do not know any thing about it, and do not pretend to.

If this room were full of ladies, I should enjoy talking to them upon the cultivation of flowers in the house, and at the same time I should take occasion to talk to the men for their neglect to keep the young men at home. I believe it is the fault of the farmers themselves that their sons do not stay on the farm, and it is a serious fact that the young men go away. It is the fault of the farmers to a large extent. Farmers, as a class, accumulate their money slowly; and they had rather put it into the bank than spend it in making their homes what they should be, — making their homes places where the young men would be happier than anywhere else in the world. When they do that, the young men will stay on the farm. I always take occasion, when I have an opportunity, to say this to the farmers. When a farmer improves his farm, makes his house pleasant, lets his son have a good horse and carriage if he wants them, gives his daughters a piano, sends them to school, gives them the best education he can, fills his house with books that are proper for them to read, he will make his house a place that the young man will be glad to return to. I have seen the evil that has resulted from the neglect of these things. I have had many men who were advanced in years come to me, and say, "What shall I do to keep my sons at home?" Well, they had run their places in this sort of way: instead of letting the boys go off to ride, to singing-school, or take other pleasures, they have kept them hard at work all the time. I always remember the singing-school with the greatest pleasure. I never could sing; but I always went to singing-school, and carried a book under my arm, and went home with the girls afterwards. I trust you will all remember this, if you have any sons whom you want to keep at home. Make that home a place where the

young man will be happier than in any other place in the world, and he will stay there.

I could not resist the temptation of saying that to you, for I say it very often when I have an opportunity. But that has not any thing to do with this silo matter. I don't suppose you are through discussing that, and Mr. Slade ought to talk upon that subject. He has asked too many questions for a person who does not know any thing about it.

Mr. Slade. If there are any questions relating to horticulture, or window-gardening, or growing hothouse plants, or any thing of that kind, Capt. Moore will stand any amount of pumping. It is a rare chance you have to ask him any of those questions.

Capt. Moore. I have no doubt that all the gentlemen present would enjoy flowers in their houses; but I do not suppose there is any one in the audience, except the very few ladies who are here, who would care to hear any thing upon that subject. If the whole house were filled with ladies who desired to know what little I could tell them in regard to the cultivation of plants in the house, or the cultivation of plants out of doors, or any thing of that kind, I should be ready to talk upon those subjects.

Question. What is the best material for soil to be used in pots?

Capt. Moore. Partially decomposed pasture soil.

Question. Any particular fertilizers better than others?

Capt. Moore. You can give it fertilizers. There is nothing better than the top sod of an old pasture, partially decomposed: but the pot wants good drainage; that is, plenty of pieces of broken pot in the bottom. Do not crowd the soil into the pot. You want to put it in loosely: the drainage will be better, and the plant will grow better. Otherwise you make it soggy. Do not water over-much; neither dry up your plant. You cannot tell that a plant is dry by simply looking at the earth on the top. The true way of watering a plant in the house is to give it a thorough watering and then let it go, not keep a constant drizzle over it: that keeps the top wet; and when you look at it you think it has moisture enough. But the soil may appear wet on top, and the roots be dry. I have two large greenhouses where I am growing hybrid perpetual roses as a specialty; and my

son, who has charge of them, is so careful about watering the plants, that he would be unwilling to have me water them. He would not allow any gardener in Massachusetts to water them, because it is a very difficult thing. I do not mean to say that there are not plenty of gardeners who would water properly, but there are plenty of them who would ruin the plants by water. He is so expert at that (though no more expert than very likely I should be after a few trials), that, by the least thump on the pot, he can tell whether there is sufficient water for the plant or not.

One great trouble that the ladies experience in growing plants in the house is from insects. The time to kill those is before you have any of them, as the Irish would express it; that is, they increase very fast, and the time to destroy them is when they first make their appearance. The worst rascal of an insect is the little red spider that works on the under side of the leaf. A great many people do not know that they have it on their plants, until the leaves all turn yellow. They begin to work on the midrib of the leaf, and you will find a little streak of yellow there; and some of the ladies who are most successful in growing plants in the house will detect that at once, and, without waiting to get a dish and sponge to wash it off, they will take hold of the leaf without any ceremony, and draw their finger along on the under side of it; and it is very bad for the spider. They are a very tender little insect, not much larger, many of them, than the point of a pin; but they are very destructive, and they oftentimes destroy the foliage of your shrubs and your plants in the garden when you do not know what is the matter, unless you are acquainted with the cause.

QUESTION. As "an ounce of prevention is worth a pound of cure," is there any way of preventing their coming at all?

Capt. MOORE. You will not know where to apply the remedy until you detect the insects, because you do not have them all the time, nor everywhere, and you would be applying the remedy all around, perhaps where there is no need of it. The great naturalist, Huber, in describing the increase of the *aphis* (I am not telling you this as my own belief, for it seems to me almost incredible), says, that, if the whole increase of a single green fly that you see on a plant in the spring escaped injury, the weight of the insects would amount, in one season,

to more than the weight of the population of China, which is the most populous country in the world. That seems incredible, but still it is accepted by botanists as being true.

QUESTION. How often should the soil be replenished in the pots?

Capt. MOORE. It depends upon the variety of the plant. A mistake that most people make is in giving plants too large pots, and shifting, as gardeners term it, from a small pot into too large a one. It is better to make only a small shift. A small plant will bloom better in a small pot than it will in a large one. The reason is this, — that a plant in a pot does not bloom well until the growth is checked by the size of the pot; that is, the pot gets full of roots, and the roots become cramped, and that forces flowers.

A great many of our plants and our roses we grow in pots of the same size two or three years. We may take them out of the pot and reduce the ball, and repot them in the same pot. The method of growing hybrid perpetual roses is a long story. It is an unnatural thing to bloom a hybrid perpetual rose in the winter: it is a deciduous shrub. Deciduous shrubs all require an annual rest. They cannot be forced into bloom until they have had their rest. Deciduous shrubs naturally take their rest in the winter time: they are now taking their rest. If we take them up and put them into a greenhouse before they have had their proper rest, we cannot force their flowers: therefore, to provide against that, we are growing these plants in pots. Those blooming last winter we encourage to get a strong growth, and they get considerable growth before it is warm enough to put them out of doors. They are then plunged into the ground, watered when necessary, and we get a growth in the spring. We do not desire to have them make any growth after the first of July: we keep them as dry as we can and not have them shrink any, and that causes them to drop their leaves two months ealier than other roses, and they take their rest in the fall; and now they are getting ready to bloom. We have simply changed the period of growth, and given them a period of rest, as they would have it naturally.

QUESTION. Does root-pruning tend to produce blossoms?

Capt. MOORE. It would if they had too large a pot. It amounts to precisely the same thing as cramping the roots.

Root-pruning fruit-trees in the garden stops their growth, and causes them to form fruit-buds, and blossom and bear fruit immediately.

QUESTION. Then, ordinarily, you would not disturb the roots of the plant much when repotting?

Capt. MOORE. If we had any roots that were in the way when repotting, we should cut them off. We handle things roughly sometimes in these operations.

QUESTION. In raising tomatoes, we are troubled with large, ugly worms that eat the leaves badly. They are so near the color of the plants that we cannot see them. What is the best preventive for them?

Capt. MOORE. There is no trouble in finding them. You will find the worm close by where the fresh castings are. I do not know of any other way of killing them, except finding them and picking them off. It is a safe way. You have seen a miller early in the spring as big as a small bird: that is the miller that deposits the eggs of those insects. I will say, that, if you find a bug around your garden, no matter what it is, it is safe to kill it. Then you may hold an inquest afterwards, and, if you find you are wrong, you can apologize; but it is the safest way to destroy them.

QUESTION. I would like to inquire how far apart you set your peach-trees. I did not understand you yesterday.

Capt. MOORE. I will tell you how far apart I set my trees, and give you the reason why I plant them so. The custom is to set peach-trees twelve or fourteen feet apart; but I have set mine eighteen or twenty feet apart. I have more land than I can cultivate properly, and I have not half as much land as many farmers here. If you plant them eighteen or twenty feet apart, you have an abundance of room to cultivate between the trees, you have an abundance of light and air about the trees; and the result is, that you have better trees, larger fruit, and much higher-colored fruit, because you get the light and sun between the trees, and they have a free circulation of air.

QUESTION. What varieties of peach do you recommend as the most successful?

Capt. MOORE. There are but three or four varieties that I should plant. In the first place, you must take the condition of the markets. I am speaking now of growing them

for market. The markets are supplied from the South (we have not had many from the South this year) until about the 10th or 15th of September. If you grow an early peach, you have got to take a small peach, because most of the early ones are small, and that peach will meet the competition of the large later peaches from the South, and you will be under a disadvantage: therefore I do not want a peach any earlier than the Early Crawford. It is called the "Early Crawford" because there is a "Late Crawford" that is later: but it is not an early peach; it is a peach that usually ripens from the 10th to the 15th of September. I take that for one variety, the Late Crawford for another, and the Old Mixon for another. Then I think I should plant the Foster; though the Foster resembles the Early Crawford somewhat, only a little rounder, and perhaps a little higher colored. But there is danger in planting too many Late Crawfords: not that they would not sell; but you are likely to have, once in four or five years, a season like this last one, when your peaches may be frosted on the trees. I had quite a lot of Late Crawfords frosted on the trees this year: it injured their looks; but they brought about two dollars a basket more than they would if they had not been frosted. I am willing to stand any thing reasonable. I put up with it, of course.

Question. In growing turnips, about the first of July, usually (some years the latter part of August), the leaves will turn yellow, apparently stop growing for a while, and afterwards they will somewhat recover from it and grow; but the turnips are usually poor in the fall when we pull them up. I would like to know what is the cause, and what the remedy.

Capt. Moore. I do not think I can tell you much about turnips. I will say, further than that, that I have changed my whole course of farming within five years; and, instead of growing a large number of crops, I am growing but few crops, and growing those very largely. I find that is a much better way for me. If you want to ask me any thing about onions, asparagus, strawberries, or dandelions (those are the principal crops that I raise, except grass, peaches, and grapes), I can answer those questions.

Question. What is the best kind of strawberry to raise for the market?

Capt. Moore. That is what I have been trying to find

out. Perhaps some of you can tell me. I have been asked that question, I presume, a thousand times since midsummer. Perhaps Mr. Slade, who has been investigating the strawberry, can answer it. I cannot.

QUESTION. How late would you plant onions in the fall for early spring onions?

Capt. MOORE. I don't raise them that way. I simply raise them as a crop for the market, — three acres. That is all that I sow in the spring.

Mr. PHILBRICK. I can answer that question. We usually sow them from the 20th of July to the first of August.

Capt. MOORE. Wouldn't you plant sets in the spring, rather than sow the onions in August?

Mr. PHILBRICK. If they failed to keep over, I would plant sets. Sometimes winter onions keep very well. When they do, they are more profitable than sets, because it costs very much less. Then, they need very rich land; and they need to be sown upon land that drains easily, so that there shall not be any wash upon them in winter; and sometimes we give them a little covering, such as broken boughs, — very much such covering as we give strawberries.

Mr. SLADE. I will answer the question in regard to turnips. The trouble in planting French turnips is, that we are apt to plant them too early; and, after they have taken hold and grown a while, they will stop growing, and the leaf will turn yellow and finally drop off, and it is uncertain whether they will take a new start and go on or not; and, if they do, they are apt to be of inferior quality. Some years ago I raised five or six hundred bushels on an acre. I planted them the twenty-second day of June, — planted them by hand, — and they came up, and did nicely until about the 20th of August; then they turned yellow, stopped growing, remained so for a time, and after a while they started again, and finally matured: but they were very poor; they were watery, and some of them were rotten inside. Now, the way to raise those turnips successfully is to get your ground in order late: put them in, and force them right through. The best turnip is one that does not stop growing: it goes on from the time that it takes root until it matures.

Mr. PHILBRICK. When would you recommend sowing them?

Mr. Slade. I sowed one year the twenty-third day of August; but that is too late, unless it is an unusual fall. I raised a few this year. I put them in about the 20th of July; and I think, as an average thing, that is about the right time of year to do it. But you will have no difficulty in raising them, provided you get your ground in good order, and put on fertilizers or manure, or something to make them go ahead, so that they shall not stop growing from the time they start until they mature. The quality of the turnip is much better when grown rapidly than when it grows slowly. If you want to get a hard, brittle turnip, force it from beginning to end.

Question. What fertilizer would you use, with the exception of bone?

Mr. Slade. There are a good many kinds that it will do to use. Standard Peruvian guano is first-rate.

Question. Would that not make them strong?

Mr. Slade. No, sir. A great many use Darling's animal fertilizer, for instance. I do not wish to recommend any particular fertilizer, but I speak of that because I know a great many raise them with that. Some of the higher-grade phosphates are excellent.

Question. Did you ever use the Stockbridge fertilizer on turnips with success?

Mr. Slade. No, sir, I never did.

Question. That has been a question in our farmers' club. We cannot find a member who can raise good turnips with the Stockbridge fertilizer. There will be a black spot on them, or a good many black spots.

Mr. Slade. I do not know whether that is owing to the fertilizer or otherwise.

Question. How would you apply the fertilizers?

Mr. Slade. I would apply them in the drill where I was going to plant the turnip, and cover them with a little earth.

Mr. ——. I find it much the cheapest to prepare the ground, and then sow them with a hand-sower.

Mr. Slade. Yes, sir: sow them with a seed-sower.

Question. I would like to inquire of Mr. Moore what kind of fertilizer he considers best for onions, and how much he would put on an acre.

Capt. Moore. You can put on ten or twelve cords of

horse-manure; and, if you put on another ten or twelve cords, it won't do any harm. I do not have any trouble in spreading from heaps, so as to go from one heap to another, and know I have got manure all over the ground. Then I use considerable potash salts. I would rather have wood-ashes, if I could get them.

QUESTION. What we farmers want to know is how much manure is profitable.

Capt. MOORE. I don't know. I have never used, probably, more than ten cords to the acre, besides three or four hundred, sometimes five hundred, pounds of muriate of potash, and sometimes a little bone besides.

QUESTION. Suppose you could get ashes, how many bushels would you put on an acre, besides the manure?

Capt. MOORE. It would depend upon how cheap I could get them. You see, where you are manuring a good many acres, you find the cost of fertilizers and manures runs up to a pretty high figure. It does on my place, and I have only a small place to what some of you farmers have here, I suppose; although I have to pay out about five thousand dollars a year for labor, and I have to raise enough to pay for the labor.

QUESTION. In putting on your ten cords of manure for onions, do you plough it in, and, if so, how deep?

Capt. MOORE. The way I have done the last two years is this. Of course, I intend to keep all the weeds out of my onions, although they do get weedy sometimes towards the last of the season. Purslane is the stuff that bothers me: but we get that out; we do not allow it to go to seed if it is possible to prevent it. When we pull those onions, if there are any weeds left, we clean them off. By the first of October there will be some more weeds growing, and we go over the ground with a harrow, which discourages the weeds; and, if you get them killed, you won't have the same ones to contend with next year. Then the next spring we put on our manure, and go over it with a disk harrow, and stir it up pretty well. If there are any lumps on it, we put on the leveller and break them up. I do not care about stirring the ground more than three inches deep. I do not think there is any thing lost by pulverizing a piece of ground for onions very thoroughly indeed. There is nothing lost in

doing it: there is something gained. Then, if you undertook to sow that ground, even after you had levelled it with the leveller, you would find more or less rubbish left there. You might sow the seed; but, when you came to hoe it with the scuffle-hoe, you would find more or less sticks and stones, or something of that kind. I do not want that rubbish on the soil: so I think it is economy to get it out of the way, and a man takes a horse with a swivel-plough, and runs that about three inches deep, going back and forth, with two men following him with rakes; and, if there is any rubbish in the way, it gets raked up and put into the furrow, out of the way of the scuffle-hoe. If there are any stones as big as a hen's egg, I tell them to pick them up and throw them out. Unless the ground is very hard, we use a scuffle-hoe. If the ground gets hard, get one of those onion-hoes, — not one of those that you can buy in a store (those are not good for any thing), but such a one as Mr. Ware sent me; but if the ground is not hard, a scuffle-hoe does the work a little better than that does. It is used in Arlington. It is not for sale in the stores in Boston, but you can get it there. I know just about the time it takes to hoe rows that are eighteen rods long. It takes just three minutes to hoe a row, because I have done it a great many times on time. You could not do that if there was any rubbish in the way; and with this scuffle-hoe, if you struck a stone or a stick, very likely out would go your hoe, and over would go a foot or two of onions at the same time. That would happen sometimes with the wheel-hoe, if there were any stones or rubbish in the way; perhaps not to a great extent, but it would happen sometimes, if you undertook to run it rapidly.

There is an idea going about that an onion-bed must be hard. I think you do not want the surface extremely hard, and you do not want very deep tillage under it. I do not know as deep tillage does any hurt: I am not going to say it does, because I know the Arlington folks will grow onions (by the way, they do not grow near as good onions as I do). They will grow four or five rows of onions, and then grow celery. Of course, the ground is stirred up very deep when used for celery. They grow good onions, nevertheless; but then they use a little manure on their land, where they are going to get two or three crops, — perhaps a little more than I

do. They would not be satisfied with eight or ten cords to the acre.

QUESTION. Do you have any trouble with the onion-maggot?

Capt. MOORE. A little, not much. Where they get to work in a bed, the top turns yellow and falls over: it is partially cut off from the other part. A large portion of those maggots are left in the piece that falls over. Have a boy go along and pick up those tops, and you secure in that way the maggots that would soon be at work upon another onion; then the safest thing to do with them is to put them in the stove. That keeps them down better than any thing I have found. I do not know any actual preventive.

QUESTION. What is the best kind of onion to raise to sell in Boston market?

Capt. MOORE. The middling size, round, thick yellow onion, that is called the Danvers onion sometimes. Be sure you get the right seed: otherwise you will wish you hadn't had any onions.

QUESTION. Where do you get the seed?

Capt. MOORE. Well, that is another thing. I am not advertising any seed-man. I can tell you where I get mine usually. This breeding of seed is on the same principle, precisely, as the breeding of animals, — that "like produces like," — to a certain extent. I start with the best thing I can get; and then, after having formed in my own mind a model of precisely what I want to have my onions, I go to work and select the onions myself. I cannot send a man to do it: I must do it myself. You cannot send a man to pick out any thing of that kind, because there is some little point that the man will overlook; and you do not want to propagate those points. One of them is a little softness close to the stem. A solid onion up there, with a very small stem, and a little rising just at that point, is an onion that will keep a great deal better than one that has any depression there. After selecting onions of the shape and size that I want, I put those away for seed, and I plant them out, and grow the seed myself. Then I do not try to save every lot of seed I have. If I raise the seed myself, I have enough of it; and I want to sow good, solid, heavy seed, after I have it.

QUESTION. How long will onion-seed keep?

Capt. MOORE. Well, it is said to grow well enough for two years. It is sufficient to sow it the first year. Some one asked what was the best strawberry. Mr. Slade can answer that question.

Mr. SLADE. Well, gentlemen, there is not any *best* strawberry. A strawberry that might be best with me might not with you. If any one desires to go into the strawberry business, let him experiment with a few varieties, carefully selected, and decide for himself. Nobody can tell you what the best strawberry is for you. I can tell you what strawberry does well with me, but I cannot tell what does well with Capt. Moore. So that the question, although pertinent enough, is really a foolish one, to ask a man what is the best strawberry; because a strawberry that does well with me might prove worthless with you. If you are going into the strawberry business, my advice is to try a few prominent varieties. You will learn at the end of the first year which is the strawberry for you to raise.

QUESTION. What are three or four of the best kinds for market to try?

Mr. SLADE. The Wilson strawberry has been *the* strawberry for the last dozen or fifteen years. Amateurs have grown other varieties; but the regular strawberry-grower, who has furnished strawberries for the million, has grown the Wilson. Within a few years, several new varieties have been presented to the public, and some of them are rather promising. Among them I would mention the Sharples, the Crescent, the Glendale, and the Charles Downing. There are still other new varieties that come very highly recommended; such as the Manchester, said to be the most remarkable berry that has ever been offered to the public, and which is going to have its run, like the others.

QUESTION. Have you found any strawberry that will yield the quantity that the Wilson has done?

Mr. SLADE. I think the Crescent will yield as much as the Wilson.

QUESTION. What is the quality of the Crescent?

Mr. SLADE. It is about No. 3. There is a good deal said against the Wilson; yet I would rather take my chance with that now, were it not for its liability to blight, than with any other strawberry that I have ever seen.

QUESTION. If you were raising strawberries for your own table, should you raise the Wilson?

Mr. SLADE. I should.

QUESTION. Rather too acid, is it not?

Mr. SLADE. The Wilson strawberry is not ripe when it turns red, nor even the next day, nor the day after; but, if you pick it three or four days after it has turned, you will find that the flavor has changed: the acid has softened down, and you get a most delicious berry. But you have judged of the Wilson in an imperfect state of ripeness.

Capt. MOORE. Will it do to send to market in a ripe condition?

Mr. SLADE. The gentleman spoke of raising them for your own table. No, sir. You have got to pick the Wilson pretty soon after it turns in order to get it to market in good shape. And, by the way, this is a great fault with a large number of the berries that are offered to the grower, — they are a soft, spongy fruit. You know they ripen in hot weather; and it is very difficult to get a variety of fair quality that will do to carry to Boston, and then reship after it gets there. There is where the difficulty is. What strawberry-growers are now looking for, is a variety that will stand shipment to Boston and reshipment; because, if all the berries that are sent to Boston are to be consumed there, Boston market would be glutted at nine o'clock in the morning.

QUESTION. Do you advise raising them in hills?

Mr. SLADE. No, sir, I do not. I have tried them both ways, and finally come to the conclusion, that, every thing considered, it was better to raise them in matted beds.

QUESTION. Set them out in hills, and let them run?

Mr. SLADE. Yes, sir.

QUESTION. The rows what distance apart?

Mr. SLADE. The rows about four feet apart; the plants sixteen or eighteen inches.

QUESTION. How many crops do you get before you discard them?

Mr. SLADE. I get from two to four. There is a little insect known, where strawberries are raised, by the name of the strawberry-flea, which eats the leaf after the crop is taken off, perforates it so that the leaf fails to perform its function, and a great many of the plants die; and he will find his way

to neighboring beds, and commit depredations in the same way. It is not easy to get rid of him: I do not know but it is impossible. That difficulty frequently occurs the first year that the crop is taken off; and the remedy is to plough immediately, and get him out of the way. Don't try to exterminate him in any other way, because it cannot be done, according to my experience. I have tried several remedies. I put on sulphate of copper once, and I put on Paris-green once. I have put on something that finally killed him, but it killed the plants also.

QUESTION. Have you tried to get the witch-grass out of your matted beds after the first year?

Mr. SLADE. Yes, sir: I always do when I intend to keep them over. It is somewhat difficult, but it can be done.

QUESTION. What are the particular merits of the Sharples?

Mr. SLADE. The Sharples presents a very good appearance to the customer.

QUESTION. Large and well-colored?

Mr. SLADE. Yes, sir. Its flavor is not any thing extra. But I have not tried it enough to know what its real qualities are. I took twenty-two berries from a quart promiscuously, put them on a plate, and set them in a cool room, and they remained there from Monday evening until Friday noon. We ate them then, and they had not decayed any as far as we could perceive, and the flavor had somewhat improved. I do not know what experts may think about it, but I do not think the flavor of the Sharples is first quality. It is a very good, showy berry to sell.

QUESTION. Is it earlier, or later, than the Wilson?

Mr. SLADE. There is not much difference.

QUESTION. Some years ago the Cutter was a very popular variety. Has that passed by?

Mr. SLADE. Yes, sir: that has passed by.

QUESTION. Don't you think the Cutter is about the best-flavored berry there is?

Mr. SLADE. It is a very good flavored berry, and requires much less sugar to make it palatable than the Wilson, or almost any other variety we have; but nevertheless it will not do to cultivate it if you have to ship your berries. If you want them for your own use, perhaps it is as good a berry as you can find.

Question. Do you know any thing about Burr's Mammoth?

Mr. Slade. I do not.

Mr. ——. I saw that at Norfolk, at Mr. Young's place, and he recommended it as the best variety. It was certainly a very large berry, and made a magnificent show. If any one wants a new variety, I would just say that that is a berry that has the recommendation of such a man as Mr. Young.

Question. Why do you adopt the matted system?

Mr. Slade. One reason is, that I can get more berries from the matted system than I can from keeping them in rows or hills.

Capt. Moore. Would that not depend on the variety somewhat?

Mr. Slade. Yes, sir, I think it would. I was thinking of the Wilson when I answered that question. If I was going to raise the Jucunda, or the Great American, or the General Sherman, or any large berry, I would raise them in hills. A large berry requires pretty high culture.

Question. Do you think it is money-making business to raise strawberries at eight cents a box in hills?

Mr. Slade. I don't think it is. I think there is other business that would pay as well as raising strawberries at eight cents a quart.

Mr. Shaw. I do not know any better berry to eat than the Cutter. I think, as Mr. Slade says, that the Wilson is one of the best berries, if you let it ripen. After you get through picking your crop of Wilsons, if you will go out into your field two or three days later, you will find some splendid berries, as fine as you ever ate. They are acid at that time, but it is an acid that will accommodate itself to your system. But when we pick the Wilson to carry to market, it is like some of the peaches that come from the South: they are not fit to eat; they are not half ripe. They do not taste like the peaches that we pick up under our trees, because they cannot let them ripen on the trees at all; and you cannot ship a strawberry and have it perfectly ripe.

Mr. Slade. There are a good many kinds of strawberries that are splendid berries under a high state of cultivation; but they are almost worthless if raised without high cultivation. For common farmers to raise, as a field-crop, they are almost worthless.

Question. Why should not common farmers raise them under a high state of cultivation?

Mr. Slade. Because, when they have such land as I told you about the other day, when they undertake to pick the stones, they will find enough to fill a drain. It is a good deal of work to get the ground into a proper state.

Mr. Capen. In regard to the Wilson strawberry, I will say that it is not ripe until it colors nearly black, something like the Black Prince. It more nearly resembles the Black Prince than any other strawberry we have. The Prince is very dark in color, with a very high flavor. There is a good old strawberry which has gone out of cultivation (the Wood) which is perhaps as highly flavored a strawberry as any we raise.

Capt. Moore. I have two acres now in single rows, and the whole question turns upon this, really, in my judgment. There are certain varieties, like Hovey's Seedling, that throw up but one flower-stem. It is impossible to get a large crop in single rows from varieties of that kind. The Wilder is another one. No plant ever throws up more than one flower-stem. You cannot get a crop in single rows: therefore you must have them in matted beds. That has been settled to my satisfaction. That will apply to the Wilson also. I think the Wilson should be cultivated in matted beds. But when you get a strong growing variety, like Miner's Prolific, or the Sharples, or Cumberland Triumph, which is destined, perhaps, to be the market-berry here, you can grow them in rows. The Cumberland Triumph is a variety that grows uniform in shape, — every one like a hen's egg, almost, every one smooth. It will run the whole season of large size. Its fault is, that it is a little soft. It is harder than the Charles Downing. The plant grows finely; but that variety, when grown in wide rows, is a different thing entirely from what it is when grown in beds. It is a light-colored berry; and, when grown in wide rows, it is high colored, and the berry itself is firmer. It is a berry that sells remarkably well in Boston market. I have two acres planted in rows three feet apart. You might ask me why I did not plant them nearer. I have, as I told you before, land enough: I have more than I can take care of properly. And really I do not find that the strong growing kinds need so much room: twelve or fourteen inches

apart is sufficient. The objection to keeping wide spaces is, that you have got to mulch the whole of that space to keep your fruit clean, whereas, under the matted-bed system, you have simply got to mulch between the beds; but the result of wide spacing is, that the fruit is always larger, and is more easily picked, and, while there is but a single row, you will be astonished at the pile of berries you will get from it. Then there is another thing in its favor over the matted bed. When you leave them, after the spring cleaning and mulching the rows is done, you are supposed to start in clean; but, by the time you have done picking, there are a good many weeds in your strawberries, if your land is rich. Now, by the matted-bed method, it is a good deal of work to clean out those beds. Under the other method, I found it very little work last year. I wanted to see how I could clean that bed in the easiest way. I had an old cultivator the frame of which was good. I pulled all the teeth out except the front tooth, and went to a blacksmith and had him make a steel knife, with arms turning up, on precisely the same principle as a horse-hoe, and had that put on the hind part of that cultivator, just wide enough so that I could leave about four inches each side of those rows of strawberries. Before we used that, some time, perhaps, about the 10th of July, we mowed every thing down clean. You could see nothing but the mulch of old hay, and the leaves that were drying up. We cut them all down clean, raked up the leaves, and went on with a horse and cart and carried them off. You will see at once that we could not clean that ground properly without getting that stuff out of the way. We have that stacked up, and have since been using it for bedding. Then we took this instrument which I have described, and run it through the rows, cutting three or four inches deep, with a good strong horse. That is the kind I use on my place, — a horse that weighs thirteen or fourteen hundred pounds, and has enough to eat. The instrument drew pretty hard, but the horse took it through the row without any trouble. There were enough weeds to hold the earth together, and it did not turn it over nor break it up. I have found since, that there can be something in the shape of a clothes-pin rigged on to tear that up. After doing that, we took French's cultivator and went through, and every thing was killed except on the space of

six or eight inches where the plants stood. I can take one of these scuffle-hoes that we use to weed onions, and just run that through, and it is but very little work to weed the plants. Now I have the weeds out, and have nothing but the stems of the plants sticking up. But by the middle of August or first of September there was not so handsome a strawberry-bed in Concord as that. It is no injury to take those leaves off; it is a benefit: and it is by mowing, and carrying off the leaves, that you get rid of the little flea that eats the tender leaves that come up.

My neighbors wondered why my strawberries grew so well. I got a fertilizer. It was not a high-priced fertilizer, though it was a fertilizer that analyzed high in value. Professor Goessmann made it to be equal to some of the best Stockbridge fertilizers. My first idea was to put on about a ton to the acre. I thought that was a fair thing to do: and, if you are going to cultivate strawberries, it is no use for you to give them fertilizers in homœopathic doses; it will not answer the purpose. I finally concluded that I would not put on a ton to the acre, but I would take out two or three hundred pounds, and substitute for it two or three hundred pounds of muriate of potash. The leaves had started somewhat before I got that ready to put on, and I thought that I might have some trouble from burning the leaves; but I took the fertilizer and the muriate of potash on a day when there was no dew, and put them on, and I was so afraid that it would not be done properly, that I followed with a corn-broom, and swept the whole of those leaves afterwards, and I had no trouble. But I left the business to be finished by the men. A shower came up: and one row that was not swept looked a little sick for a few days afterwards; the leaves were burned. So that you will find that you can use a good corn-broom to advantage in just such places as that. I do not claim that as any new invention, for I presume other people have done the same thing.

Now I have as fine a bed of strawberries, and perhaps as good-looking a bed, as there is in the town of Concord. I have a matted bed besides; but the cost of cleaning the bed to which I have referred would not be half as much as the cost of cleaning the matted bed, although the cost of cleaning a matted bed is not so much as you would take it to be

at first thought, if you use one of the forked hoes to stir up the ground.

The Board then adjourned *sine die.*

ANNUAL REPORT OF THE COMMISSIONERS ON CONTAGIOUS DISEASES AMONG CATTLE.

The Commissioners are gratified to be able to report that the year 1881 has been one of general health with the neat-stock of the State, and that our stock interests have been unusually prosperous. In our last Annual Report the attention of the Legislature was called to the fact that contagious pleuro-pneumonia existed in several sections of the country, and that it was alleged in England that cattle exported from the port of Boston had been found infected with it, causing apprehension among our stock-owners lest there might be an outbreak of the disease here, and throwing suspicion upon Boston as a cattle-shipping port. Mention was also made of investigations then in progress by agents of the United States as to the truth of the allegations. These investigations have been continued; and it is now believed that while this disease exists in certain sections of New York, New Jersey, Pennsylvania, Maryland, and Virginia, not a case of it has ever occurred west of the Alleghanies, and that the suspected cattle from Boston were affected by ordinary lung-disease, induced by foul air on shipboard. But the apprehension of danger from the disease remains in full force; and as a result the Commissioners are frequently notified, by private persons and municipal officers, of supposed cases of it. In July the selectmen of Lanesborough, in Berkshire County, requested us to examine the herd of a farmer of that town who had lost five animals and had three others sick, the symptoms of which were thought to resemble those of this disease. The herd was examined, and a *post-mortem* made of the animals, and the trouble found to be sporadic pneumonia. There have been other cases of lung difficulty, but none of them of the contagious type. The Commissioners entertain the opinion that there is little danger of the appearance of this malady in localities remote from the great lines of transportation. Inflammation of the lungs, or tuberculosis, may be

engendered in the stock of any farm by undue exposure, want of ventilation, or confinement in damp and filthy enclosures. But contagious pleuro-pneumonia, which has symptoms resembling those diseases, is the result of contact with an animal possessing the infection, or with some object he has infected, and is disseminated from animal to animal, like small-pox or measles in the human family. The appearance of lung-disease on remote and isolated farms, unless it can be traced to contact with animals from abroad, should cause no alarm, but should prompt their owners to a careful hygienic examination of their premises, and methods of stock management. So long, however, as this cattle-plague exists in four of our sister States, and their cattle are not forbidden to mingle in the great current of trade, so long there is danger of its dissemination along the lines of transit. Twenty years ago, and when it was widely spread through the State, Massachusetts "stamped" it out at an expense of more than two hundred thousand dollars, and not for the benefit of itself alone, but for the whole country; and it would appear that common interests, and comity between the States, should induce a like action where it now exists. The ravages of this disease in other countries have cost them millions of dollars, and to prevent a like result here is an object worthy the combined action of the State and National governments.

To prevent the introduction of Spanish-fever to our herds, the Legislature of 1876 enacted that no Texas or Cherokee cattle should be brought into the State between the fifteenth day of May and the first of November. Other States in the West, where it had caused great losses, had a similar statute; but, in a contested case before the United-States court in Missouri, it has during the last year been declared unconstitutional, because it attempted to interdict or control commerce between the States, — a power possessed only by Congress. Assuming a like result would follow in a contested case in this State, and that our enactment was void, representations of the case were made to the Legislature at its recent special session for the revision of the Statutes, and the law complained of was stricken from the code. For it was substituted an Act giving the Commissioners power to take possession of all such cattle when brought within the State, and to confine them to the premises of the railroad transport-

ing them, or to make such disposition of them as to prevent the exposure of our native cattle. Sufficient time has not elapsed to decide the efficiency of the Act, but it is apprehended that railroad interests and convenience will interpose serious obstacles to its enforcement. The dangerous and insidious disease of glanders in horses has not diminished since our last report. The germs of the disease appear to be quite generally diffused through the State, except in the south-eastern section, and in the counties of Berkshire and Franklin. The enactment of 1881, removing the obligation to appraise and pay for animals condemned and killed, has materially simplified the duty of the Board, and must eventually diminish its expenditures: it wrongs no man, for the glandered horse is not only valueless to his owner, but a source of constant danger. The municipal officers of the towns or cities have called for the aid of the Board in fifty-seven cases; and of these, forty have been condemned, and ordered to be killed. The Commissioners are firm in the belief, that as soon as horse-owners are cognizant of the fact that no compensations can be received for condemned animals, and that to call for their aid is simply to ask for an order for the death of the subject if found diseased, the owners or officers will destroy all pronounced cases, and hasten the work of suppression.

On the 25th of September the selectmen of Charlemont, in Franklin County, notified the Board of the existence of a malignant and apparently contagious disease in the swine of a farmer of that town, and requested us to take control of the same. The locality was visited, and an examination made of the diseased animals then living, and a *post-mortem* made of one which had died the day of the visit, which established the fact that the disease was hog-cholera, or swine-plague, and in all important respects identical with the scourge which has made such havoc in this class of stock at the West and South. The circumstances attending the development of the case were very unusual and peculiar; but to guard the public along the lines of rail transportation from the recurrence of a like calamity in the future should be placed before the public. It appears, that, on or about the 12th of August, a freight-train on the Tunnel Railroad was derailed a short distance from the Charlemont depot. In the train was a

carload of swine billed from the West to some slaughtering establishment near Boston. The animals were released from the cars by the accident; and the State agent of the railroad, to prevent them from straying away, caused them to be driven to, and secured in, the yards of Mr. E. C. Hawkes, a farmer, whose residence was less than a half-mile from the depot. There were one hundred and seventy of the animals, about twenty of which indicated sickness, or slight injuries from the accident, supposably the latter. After remaining in the yards of Mr. Hawkes two days, they were all forwarded to their destination, though several were so feeble that it was necessary to carry them to the cars. Mr. Hawkes was a large owner and breeder of choice swine, and, at the time of the accident, had in his pens adjoining the yards where the Western hogs were confined one hundred and eighteen of these animals of different ages. About ten days after the hogs from the railroad were removed it was noticed that quite a number of them refused their food, appeared sick, and manifested behavior quite like that of the supposed injured animals. The disease developed rapidly: numbers of them soon died, and it spread to all the pens and enclosures. Various remedies were tried without effect; and, at the time the Commissioners were notified, more than half the stock had been lost.

Not knowing the disease with which his swine were troubled, or its cause, and hoping to save some of them, Mr. Hawkes had removed a number to an outlying farm two miles away, and turned them into an open field; but they carried the disease with them, and made another centre of contagion, causing serious alarm throughout the vicinity, to allay which, and remove the difficulty, appeared to require severe repressive measures. As chap. 24 of the Acts of 1878 had extended the powers and duties of the Commissioners for the suppression of contagion among cattle to "the prevention of contagious and infectious diseases among domestic animals," and as this was surely such, and circumstances made it peculiarly dangerous, it was determined to apply the provisions of the law applicable to herds of cattle infested with contagious pleuro-pneumonia. Accordingly, on the 13th of October, the entire stock alive at that date (fifteen in number) were slaughtered. Of these, six on inspection were ad-

judged free from disease, and were appraised and paid for. Measures were taken for the safe disposition of the carcasses of the diseased animals, and the disinfection of the premises; and there have been no cases on the adjoining farms. That the disease was the dreaded swine-plague of the West, and that it was communicated to Mr. Hawkes's stock by the animals taken from the cars, there is not a shadow of doubt. Through no fault of his own (for the hogs from the cars were taken to his yards in his absence, and without his consent) Mr. Hawkes met with a great pecuniary loss. The result should lead all to great caution against similar exposure. The last appropriation for the purposes of the commission was $2,000.

There have been allowed and paid bills to the amount of $1,949, and there are now outstanding bills to the amount of $600; leaving a deficiency to be provided for of $549. The expenses incurred by the Board the past year have been unusually large, caused by the greater number of calls for aid, the distance travelled, and the peculiar character of some of the cases. The eradication of glanders from one centre of infection at Taunton was effected only by an expenditure of $500. With the facts of the past year before us, if the work of the Board is to be continued, we recommend an appropriation for the ensuing year of $2,500 in addition to the deficiency now existing.

Levi Stockbridge,
E. F. Thayer,
H. W. Jordan,
Commissioners on Contagious Diseases among Cattle.

Boston, Jan. 10, 1882.

ANNUAL MEETING OF THE BOARD.

The Board met at the office of the secretary, in Boston, on Tuesday, Jan. 31, 1882, Mr. Wilder, chairman of the Executive Committee, in the chair.

Present: Messrs. Anderson, Baker, Bird, Bowditch, Farnsworth, Fay, Gaylord, Gleason, Grinnell, Goodrich, Hadwen, Haskell, Herrick, Hersey, Hill, Jewett, Lane, Lynde, May-

hew, Moore, Nichols, Pierson, Sessions, Smith, Slade, Taft, Varnum, Ware, Wakefield, and Wheeler.

Voted, To adopt the order of business of the last annual meeting.

Voted, To appoint a committee of three to examine and report upon the credentials of new members, — Varnum, Bird, and Mayhew.

Reports of delegates to the agricultural fairs being next in order, —

Mr. Pierson reported upon the Middlesex South, Mr. Sessions upon the Worcester South (Mr. Bird reported that the Worcester South-east, to which he had been assigned, did not hold any fair), Mr. Hersey upon the Hampshire Franklin and Hampden, Mr. Wheeler upon the Hampshire, Mr. Anderson upon the Highland, Mr. Ware upon the Hampden East.

After an adjournment of one hour, Mr. Hersey was called to the chair, and the reading of reports was resumed.

Mr. Gaylord reported upon the Union, Mr. Herrick upon the Franklin, Mr. Mayhew upon the Deerfield Valley, Mr. Slade upon the Berkshire, Mr. Gleason upon the Housatonic, Mr. Jewett upon the Bristol, Mr. Taft upon the Plymouth, Dr. Wakefield upon the Marshfield, Mr. Goodrich upon the Essex, Mr. Perkins (read by the secretary) upon the Hingham, Mr. Farnsworth upon the Worcester North.

The Committee on Credentials of newly-elected Members submitted the following Report: that they find, —

Dr. James R. Nichols of Haverhill, appointed by the Executive.

E. F. Bowditch of Framingham, elected by the Massachusetts Society.

John B. Moore of Concord, elected by the Middlesex Society.

Velorous Taft of West Upton, elected by the Worcester South-east Society.

Henry C. Haskell of Deerfield, elected by the Hampshire Franklin and Hampden Society.

William R. Sessions of Hampden, elected by the Hampden East Society.

Chauncy L. Buell of Ludlow, elected by the Hampden Society.

Henry Noble of Pittsfield, elected by the Berkshire Society.

James M. Waterman of Williamstown, elected by the Hoosac Valley Society.

Merritt I. Wheeler of Great Barrington, elected by the Housatonic Society.

Edmund Hersey of Hingham, elected by the Hingham Society.
Daniel E. Damon of Plymouth, elected by the Marshfield Society.
Daniel Round of Nantucket, elected by the Nantucket Society.
J. Henry Hill of Amesbury, elected by the Amesbury and Salisbury Society.

Mr. Ware, chairman of a committee appointed at the annual meeting, 1878, to consider applications for the free scholarships offered to the Board by the American Veterinary College of New York, reported upon the action of his committee in the award of the scholarships. The Report was accepted, and it was voted that all present and future applications be referred to the Executive Committee.

The Board then adjourned until half-past nine o'clock on Wednesday.

SECOND DAY.

The Board met at half-past nine o'clock A.M. Mr. Arthur A. Smith was elected chairman for the day.

Present: Messrs. Anderson, Bowditch, Buell, Damon, Farnsworth, Fay, Gaylord, Gleason, Grinnell, Goodrich, Goessmann, Hadwen, Haskell, Herrick, Hersey, Hill, Lane, Lynde, Mayhew, Moore, Nichols, Noble, Round, Sessions, Slade, Taft, Varnum, Ware, Waterman, Wheeler.

Mr. Hadwen reported upon the Worcester North-west Society, Mr. Bowditch upon the Barnstable, Mr. Moore upon the Martha's Vineyard, Mr. Lynde upon the Worcester, Mr. Smith upon the Hoosac Valley, Mr. Baker upon the Middlesex North, Mr. Varnum upon the Middlesex, Mr. Lane upon the Hampden, Dr. Nichols upon the Worcester North-west.

The Board then proceeded to elect a secretary by ballot to serve for one year. John E. Russell was elected.

Messrs. Bowditch, Slade, and Sessions were appointed a committee to assign delegates to the fairs of the societies.

Messrs. Ware, Farnsworth, and Mayhew were appointed a committee upon changes of times of holding fairs.

Messrs. Moore, Lynde, and Hersey were appointed a committee to report a list of subjects for investigation, and to assign committees upon them.

Messrs. Hadwen, Herrick, Moore, Grinnell, and Buell were appointed a committee upon the holding of the country meeting.

Dr. NICHOLS read a paper upon "The Chemistry of Nitrogen in its Relation to Agriculture."

THE CHEMISTRY OF NITROGEN IN ITS RELATIONS TO AGRICULTURE.

The element nitrogen, in its nature and chemical relationships, is not clearly understood among farmers; and this is annoying to many, as it is constantly spoken of in agricultural literature. The cause of this indistinct understanding, or misapprehension, arises from the way in which it is necessary to speak of it in relation to its cost or value as plant-food, and of the office it subserves in vegetable physiology. Nitrogen, in its naked or gaseous condition, is quite unlike its various compounds; and it is only in some one of its combinations that it possesses any interest for the farmer. It has not been unusual for me to receive letters of inquiry asking where nitrogen can be purchased by the pound or ton, and what kind of vessels are needed to hold it. It is certainly desirable that its nature should be better understood.

Nitrogen belongs to a class of bodies which are incapable of influencing any of the senses so far as to be recognized by them. It cannot be seen, tasted, or touched, so as to produce tangible impressions; and it has no order. During all the ages, until within a little more than a century, mankind were wholly ignorant of its existence. It is a form of matter found in a permanently aeriform state, or as a gaseous body, which, under no ordinary or usual conditions, can be made to assume a solid or liquid form. The atmosphere is its home and hiding-place; and therefore it is constantly in close proximity with our bodies, and with every thing existing upon the earth. It passes into the cavity of the lungs of all breathing animals at every inspiration, traverses the circuit

of the air-cells, and is expelled as nitrogen, without diminution of volume, or any chemical change whatever.

The volume of free nitrogen in the air is immense; and its weight, as it rests upon the earth's crust, can only be understood by a consideration of the figures which approximately represent it. The nitrogen of the air can be separated from the oxygen and other gases and vapors present over the earth's surface, and weighed. One thousand pounds of air contains of

	Pounds.
Nitrogen	7.55
Oxygen	2.34
Carbonic acid	.01
Aqueous vapor	.10
	10.00

The whole weight of the nitrogen contained in the gaseous envelope of our planet may approximately be stated to be 3,994,592,925,000,000 *tons*.

The commercial value of nitrogen, as presented in the estimates of chemists who make analyses of fertilizers, is about twenty cents a *pound*. Apply this price to the great volume of nitrogen around us, and the value would reach a point almost beyond the reach of figures to demonstrate. For crop purposes, the nitrogen of the air is valueless to the farmer; for, although it comes in direct contact with his soils, mingles with them to considerable depths, the spongioles of plants, penetrating everywhere, are not endowed with the power of appropriating it to their uses, or combining it with their structures. It also comes in direct contact with the surfaces of plants above ground; but this contact is productive of no combination or assimilation: vital plant-structures and dead nitrogen, when brought together, do not permit of the play of chemical affinities which result in chemical unions. From a careful and candid consideration of the experiments which have been made towards ascertaining whether there is any absorption of nitrogen by the leaves or other external organs of plants, I have no hesitation in saying that they must be regarded as complete failures. The affirmative results which some experimenters state to have been reached are totally unreliable; and the question stands to-day a settled one, and that in the negative.

Nitrogen in many of its aspects, and in its behavior, must be regarded as the most remarkable of all the elements. The popular notion of its use in the atmosphere, that it is simply a diluent of oxygen, is probably correct. It must subserve other and important purposes; but, to ordinary observation, it appears to have been supplied by the Supreme Intelligence for the main purpose of so attenuating oxygen as to keep it within safe bounds as a respiratory agent and supporter of combustion. It is the most stupid, so to speak, and negative, of the large family of elements. It resists chemical combinations with remarkable persistency; and, when forced into such unions, the affinity is slight, and disruption is easy. It may be said to be the most unimportant and yet the most important of all the elements, — a paradoxical statement easily comprehended by every chemist. It is docile, negative, unaggressive in its natural state; but, when forced into combination with oxygen, it gives us acids with teeth sharp enough to gnaw a file. When combined with potash, and the resultant salt mixed with a little sulphur and charcoal, it gives us gunpowder, — an agent well known to possess extraordinary properties. When associated with the bland and sweet substance known as glycerine, it forms nitro-glycerine, dynamite, lithofracture, giant-powder, — agents so terrible as to appall mankind by their destructiveness. Shreds of cotton picked from the ripened bolls which open to the southern sun, when placed for a few moments in the acid which is born of nitrogen, suddenly lose their innocent nature, and each becomes a giant in power, capable of levelling forests and mountains at the touch of fire. Nitrogen forms the basis upon which rest the great chemical forces so destructive, and yet so useful to the race. It comes out of its chemical unions with a crash, terrible and irresistible; but it at once assumes its usual dead condition, and floats in the air with all the harmlessness of the summer breeze. When introduced into the human or animal organism, it originates and sustains nervous or muscular force. We move our limbs, and conduct the physical labors of life, through the agency of nitrogen or its compounds. Our animals, the oxen and horses which we rear, are only serviceable in the yoke and harness through the changes resulting in the combinations and elimination of nitrogen. After it has served its purpose in the body, it does

not, as a whole, escape into the air, as when it is set free by explosions, but it appears in the liquid and solid excrement in certain forms of combination, which, to become fixed and serviceable as plant-food, must receive intelligent care. The proneness of nitrogen to disassociate or free itself from its combinations is seen in the changes which excrement undergoes soon after leaving the animal organism. So long as nitrogenous compounds are controlled by the vital forces of animal life, they are held in check, and their equilibrium is preserved; but, as soon as the external air is reached, it struggles to free itself from its environments. The highly-organized compounds take on fermentative changes: hydrogen (another gaseous body) is evolved, and the nitrogen is led into an alliance with this element in such proportions as to form ammonia. Ammonia is distinguished for its volatility, or readiness of escape, whether it be free or in the form of a carbonate. When nitrogen seeks to escape through this agent, it must be fettered by forcing it into new and stronger combinations. The sulphate of ammonia is a stable body, capable of restraining nitrogen; and hence if we apply to fermenting manure-heaps sulphate of lime, or what is known as plaster, sulphate of ammonia results through a process of double decomposition, and we have a nitrogenous salt, permanent, and well adapted to the purposes of plant-nutriment.

It has already been stated that nitrogen has no value for farm purposes in its elementary, gaseous state; but, when in chemical union with oxygen or alkaline bases, it becomes a factor in successful husbandry of the first importance. An interesting inquiry arises at this point: Through what natural agencies is nitrogen fitted to become plant-food? How does it happen that an element so shy and indifferent is found in soils in a combined state, so as to be assimilable by growing vegetation?

Investigations made at my experimental farm in Essex County during the past twenty-five years lead to the conclusion that the most prominent source of fixed nitrogen found in soils comes from the atmosphere. I am quite certain that most chemists are in error in regarding as of comparatively small consequence this source of the agent. The view that nitrogen and ammonia are simply accidental agents in the air, and very sparsely diffused, is founded upon incor-

rect or superficial experiment and observation, and must, it seems to me, be abandoned. Experiment and observation have convinced me that nitric acid and ammonia are essential and natural constituents of the atmosphere, and of so much importance, and so considerable in amount, that by no means can they be made to take a secondary place in any estimate of the sources of nitrogen in soils.

Quite early in my farm experiments, before science had shed so great light upon the chemistry and physiology of plant-growth, I was perplexed to understand how it happened that the quantity of nitrogen removed in a series of crops was much greater than that contained in the manures employed, and this, too, when percolating rains and drainage were carrying away no inconsiderable quantity. Analysis proved that nitrogen was present in large quantities in some uncultivated, or virgin, soils on my farm; and also it was found in considerable amounts in the swamp-muck contiguous to my uplands, — areas which had never been cultivated, or received a particle of manure from any source. It became not only evident that nature has hidden sources of supply, but that in some way a remarkable equilibrium is maintained between want and supply, without the husbandman's intervention.

Experiments upon fields, cropping without supplying nitrogenous manures, carried on over a period of fifteen years, gave crops of the cereals in diminished amounts. The soil at the end of that period afforded, upon analysis, evidence of the presence of nitrogen, although the quantity removed in the crops was much greater than was contained in the soil at the commencement of the experiments. This proved that somehow, from somewhere, nitrogen was spontaneously furnished in the ordinary processes of nature.

The amount of nitrogen returned to the soil in the husbandry of the early settlers in this country was really very small. The manures they produced from their animals were so slovenly cared for (being exposed to rains and snows, and allowed to drain away into marshes and ditches), that they were of small nitrogenous value when used in the field. They could not, indeed, be of high value when well protected, as the grasses upon which the animals were fed were of a low order and of inferior quality. The virgin soils, when well

situated, were rich in nitrogen, and gave heavy crops of wheat and other cereals; but they gradually languished, until the raising of wheat, a grain demanding much nitrogen, no longer proved remunerative, and its cultivation, to a large extent, ceased.

New-England soils, at the dawn of scientific agriculture thirty years ago, were apparently in a fixed condition: fifteen or twenty bushels of corn could be got from an acre, small crops of barley or oats, but no wheat in paying quantities. The supply of nitrogen was at a minimum; and it probably varied but little from year to year, unless on fields which received more enlightened culture from owners than was usual throughout the country.

These facts all tend towards one conclusion, — that the spontaneous supply of nitrogen on soils physically well adapted to grains and rich grasses is tolerably constant, and is sufficient for the sustention, growth, and maturity of small crops from year to year, without additions from outside sources. Some lands, originally well supplied with nitrogen, become sterile under repeated croppings with the cereals; but such are peculiar in physical characteristics, and not well adapted to receive and retain manures of any kind. As is well known, the tendency of all soils is towards exhaustion, when drawn upon by successive crops of the noble grains and grasses; but this exhaustion seems to have a limit, so far as it is due to loss of nitrogen.

As gaseous nitrogen is rejected by plants, we must assume that it reaches them through the nitric acid and ammonia always present in the atmosphere. Every shower of rain, every fall of snow or dew, brings with it to the land a variable but large supply of these bodies; and they are diffused through the moist earth, and held for the use of vegetation. It is a very remarkable and significant fact, that the amount of nitrogen supplied through the sources indicated varies on different fields, often on the same farm, and under similar meteorological conditions. This fact has not been noticed by writers and experimenters, so far as my knowledge extends.

It appears clear, from the results of experiments at my farm, that no two fields receive precisely the same amount of natural nitrogenous products in a single season, or in a succession

of seasons; and I am inclined to think it is a law of nature, that the physical conditions of soils (conjoined, perhaps, with chemical conditions) determine the amount of nitrogen they are capable of receiving. It may be true, that, if we only knew just what conditions are requisite, the spontaneous supply of nitrogen could be made ample for all our wants. It seems to me that facts and observation point in this direction; and the suggestion, though new, is worthy of consideration.

I have found that fields kept in high culture by constantly stirring and pulverizing the soil, without the use of nitrogenous manures, uniformly gave a much higher percentage of nitrogen, upon analysis, than adjacent fields which were comparatively at rest, the crops being the same in kind. It is well known that a crop of clover raised upon a field, and turned under in a green state, adds greatly to the fertility of the field by increasing the supply of nitrogen. I have found, upon analysis of the soils of such fields before and after the decay of the clover, that the nitrogen present was greater after the crop than the amount originally present in the soil added to that contained in the clover. If the leaves and external organs of clover are incapable, as we feel certain they are, of assimilating gaseous nitrogen, it may be they are capable of appropriating nitrogen in the form of nitric acid and ammonia from the air. I have not conducted experiments far enough in this direction to settle the matter in my own mind; but I know the view quite generally prevails among chemists, that it is not through the roots alone that clover, and perhaps some other plants, receive nitrogenous food. We are still much in the dark upon this interesting question: it is a darkness, however, which I am confident will be dissipated by further and more intelligent research.

As regards the sources of the compounds of nitrogen in the air, I have only to point out the agency of the electrical forces, and the escape of free ammonia from industrial etablishments, putrefactive fermentations, and a thousand other natural and artificial sources. How far the play of electrical activities in the atmosphere, which are silent and unseen, may conduce to the union of nitrogen with oxygen, we do not know; but we have good reason to suppose they are by no means insignificant. We do know that nitric acid is pro-

duced in large amounts during thunder-storms, when disruptive discharges of electrical force are constant and powerful; and during cyclones and tornadoes the production must be immense.

I have only to add, that, in the view of many chemists, the electrical influences in the soil promote the fixation of free nitrogen to certain substances; and hence supplies of nitrogenous aliment reach plants through this agency. It is tolerably certain that this view is correct; but, to how great extent this change is carried, we do not know. We do know that through the process of nitrification, so called, nitrogen in soils under peculiar conditions is forced into combination with the alkaline bases, potash, soda, and lime; and it may be that other changes are occurring, tending to fix free nitrogen, which we are ignorant of at present.

Conclusions based on the present state of knowledge lead to the belief that the sources of nitrogenous compounds in nature, brought, or capable of being brought, within the reach of vegetation, are more numerous, and the supply much greater, than has hitherto been supposed. There is, indeed, much to support the pleasing hope that ultimately, or in the near future, our knowledge will be so extended as to make it easy to aid Nature in producing the chemical union of nitrogen with oxygen, and utilizing the products on our lands.

The researches of a quarter of a century in the field and laboratory lead me to conclude that nitrogen in available forms will not long command the high prices which it now sustains, as presented in industrial products. Within a third of a century we have had opened to us inexhaustible supplies of the other two great essentials of plant-food (potash and phosphoric acid); and it is through a clearer understanding of chemical reactions and Nature's laws that nitrogen is to be supplied to agriculture under such conditions as to immensely promote the interests of husbandry.

This essay was followed by discussions and questions that were answered by Dr. Nichols and Professor Goessmann.

Mr. Bowditch, from the Committee upon the Assignment of Delegates, reported as follows: —

DELEGATES TO FAIRS OF COUNTY SOCIETIES.

	TO	AT
Mr. Gleason	*Essex*	Haverhill.
Mr. Nichols	*Middlesex*	Concord.
Mr. Mayhew	*Middlesex North*	Lowell.
Mr. Round	*Middlesex South*	Framingham.
Mr. Fay	*Worcester*	Worcester.
Mr. Anderson	*Worcester West*	Barre.
Mr. Bird	*Worcester North*	Fitchburg.
Mr. Herrick	*Worcester North-west*	Athol.
Mr. Gaylord	*Worcester South*	Sturbridge.
Mr. Haskell	*Worcester South-east*	Milford.
Mr. Jewett	*Hampshire, Franklin, and Hampden*	Northampton.
Mr. Ware	*Hampshire*	Amherst.
Mr. Buell	*Highland*	Middlefield.
Mr. Goodrich	*Hampden*	Holyoke.
Mr. Farnsworth	*Hampden East*	Palmer.
Mr. Taft	*Union*	Blandford.
Mr. Damon	*Franklin*	Greenfield.
Mr. Slade	*Deerfield Valley*	Charlemont.
Mr. Moore	*Berkshire*	Pittsfield.
Mr. Hadwen	*Hoosac Valley*	North Adams.
Mr. Bowditch	*Housatonic*	Gt. Barrington.
Dr. Lynde	*Bristol*	Taunton.
Mr. Wheeler	*Plymouth*	Bridgewater.
Mr. Noble	*Hingham*	Hingham.
Mr. Varnum	*Marshfield*	Marshfield.
Mr. Sessions	*Barnstable*	Barnstable.
Mr. Grinnell	*Nantucket*	Nantucket.
Mr. Smith	*Martha's Vineyard*	West Tisbury.
Mr. Hersey	*Amesbury and Salisbury*	Amesbury.

Mr. Hadwen, from the Committee on the Country Meeting, reported that invitations had been received from Great Barrington, Holyoke, Worcester, and Northampton, and, after hearing all claims, the Committee had unanimously decided upon Northampton, the time to be Dec. 5, 6, and 7.

Voted, That the Executive Committee prepare a list of questions for the use of delegates to the fairs, and present them to the Board for adoption.

Mr. Wheeler, from the Committee upon the Agricultural College, was by vote permitted to make a verbal report.

Messrs. Sessions and Damon were elected members of the Committee on the College, in place of Messrs. Bowditch and Wheeler, whose terms had expired, making the Committee stand in the following order: —

Messrs. Lynde, Jewett, Slade, Sessions, and Damon. This Committee was instructed to choose a chairman, who would report to the Board at the next annual meeting.

On motion of Mr. Grinnell, the secretary was ordered to wait upon the Governor, and get his instructions in writing defining the duty of the Board as overseers of the College under the statute.

The secretary read a memorial to the Board from Mr. John Kenrick of Cape Cod, asking its influence to secure further legislation in regard to repression of forest fires. This led to discussion; and it was resolved that the State Board of Agriculture recommend such further legislation as shall be thought practicable for protection against forest fires.

Messrs. Hadwen, Anderson, and Haskell were appointed a committee to report names of delegates to form the Executive Committee.

Messrs. Hersey, Bowditch, and Moore were appointed a Committee on Printing.

The Board adjourned until ten o'clock on Thursday, Feb. 2.

THIRD DAY.

The Board met at ten o'clock A.M., Mr. TAFT in the chair.

Present: Messrs. Anderson, Bird, Buell, Damon, Farnsworth, Fay, Gleason, Grinnell, Goodrich, Goessmann, Hadwen, Haskell, Herrick, Hersey, Hill, Lane, Lynde, Mayhew, Moore, Noble, Round, Slade, Sessions, Taft, Varnum, Ware, Waterman, Wheeler, Wilder.

Mr. Anderson, from the Committee to report Names to form an Executive Committee, reported, —

Messrs. Wilder, Hadwen, Bowditch, Slade, and Moore, who were elected.

Mr. Ware, from the Committee on Changes of Times of holding Fairs, submitted his report.

REPORT OF COMMITTEE ON APPLICATIONS FOR CHANGES OF TIMES OF HOLDING FAIRS.

Several petitions, signed by members of the Berkshire Society, have been presented, requesting that the time for holding its fair might be changed from beginning on the first Tuesday of October to the third Tuesday of September. After a full hearing given to the petitioners and remonstrants, your Committee is of the opinion that the change cannot be made without seriously affecting the best interests of other societies, and the agricultural interests of Berkshire County, and therefore recommends that the petitions be not granted. It is recommended that the Middlesex Society, at its request, be allowed to begin its fair on the fourth Tuesday instead of on the fourth Wednesday of September.

Your Committee further recommends that the Amesbury and Salisbury Agricultural and Horticultural Society hold its fair on Thursday and Friday, Sept. 21 and 22.

As no other changes have been requested, the assignments of the other societies remain as before.

The Report was accepted.

Mr. Moore, from Committee to present Subjects for Investigation, reported, —

"Raising and selecting Field and Garden Seeds." O. B. Hadwen.

"Construction of Silos; Use and Value of Ensilage." B. P. Ware.

"How to keep Boys on the Farm." J. B. Moore.

"Unimproved Lands of the Commonwealth." Daniel Round.

"Value of a Protective Tariff to the Farmer." Joseph S. Fay.

"Preparation of the Soil for Growth of Crops." E. Hersey.

The assignments were accepted by the members designated, and adopted by the Board.

Voted, That the secretary petition the Legislature to establish an agricultural experiment station.

On motion of Mr. Moore, it was

Resolved, That it is the opinion of this Board, that a sum not less than ten thousand dollars should be appropriated by the Legislature for the repair of the buildings of the Agricultural College, and the erection of a small stable, and a further appropriation to build a drill-hall.

On motion of Mr. Hadwen, it was

Resolved, That it is the opinion of the Board, that any agricultural society receiving the bounty of the Commonwealth, that shall support a free scholarship at the Agricultural College, ought to be allowed a sum additional to their annual bounty of seventy-five dollars.

On motion of Mr. Varnum, it was

Voted, That each delegate to the State Board should write a brief historical sketch of his society, to be edited by the secretary, and printed in the next Annual Report.

Dr. J. P. Lynde read the following essay upon "The Sanitary Essentials of the Home and Farm."

Massachusetts affords a great diversity of eligible farm-sites, many most beautifully located, affording fine views of natural scenery worth a journey to behold.

All are convenient to routes of transportation by highway, railroad, or water carriage, communicating directly with markets in town and city. Her climate is changeable and rigorous, her atmosphere bracing and invigorating, the water from her mountain-streams and hillside springs pure, fresh, and abundant.

Within her borders the subtle malaria that in many parts of our country depresses the energies of men by fevers and general unhealthfulness is hardly known or feebly felt.

Yet so diversified is her soil and surface by river, lake, swamp, marsh, alluvial and sandy plain, by cultivation and vegetation, from stately forest to shrub and grass, and so near is she to the ocean and its influences, that all localities are not equally salubrious and healthy; and, far transcend-

ing in importance all considerations of pecuniary profit and natural beauty of situation, are those agencies and influences of Nature affecting the health, comfort, and physical welfare of her people.

THE SANITARY ESSENTIALS OF THE HOME AND FARM.

Of these, the first and most important to be secured is an abundant supply of pure air: therefore the selection of the site for a farm and the buildings thereon should be made with care and good judgment. We would select an elevated situation, where surface-water would find an unobstructed course to valley and brook, with a soil so porous as to allow a free percolation of rain and surface water to a low level. We would study the geological formation, the character, and dip of the underlying strata of rock and earth.

Rocky and stony soils are generally healthy, while a sandy soil may or may not be, depending on its freedom from, or its containing, a large amount of organic material in its strata to ferment and decay. Whether it rests on an impervious bed of clay, or has clay in its composition, such a soil will be wet, cold, damp, and unhealthy.

A healthy soil, after a storm, will readily become dry by evaporation and percolation, and have the power to absorb moisture and heat from the air.

We would examine the composition and structure of the ground about and under the spot for the house in respect to the organic constituents it might contain.

The superficial layer of all soils is more or less rich in organic material derived from vegetable and plant growth: where this is found in large quantities deep in the earth, as in alluvial and drift soils, the changes attending its decomposition from the gaseous emanations constantly given off may so affect the ground-air as to make the situation unhealthy.

The condition of the ground-water, its purity, and depth from the surface of its level, and its fluctuations, should be ascertained. Sites with a low level and great purity of the ground-water are the most desirable and healthy.

All soils are derived from the disintegration of the rocks, and the organic remains of plant and animal growth.

All rocks and soils, without exception, absorb and retain

water in their natural state, in their intimate structure; and all soils hold — under varying conditions of density or porosity, modified by vegetable growth and the deeper impenetrable layers, or stratas — either water or air in the spaces between the particles of which they are composed.

This water, chiefly supplied by rainfall and storms, obedient to the law of its nature, seeks by gravitation its level, displacing and forcing air from the earth to the amount of its bulk, it being heavier than air; and, whenever the point of saturation is reached, all the air is expelled.

Nature is said to abhor a vacuum: the ground-air, therefore, often reaches to a great depth, and is in constant circulation.

Its currents are modified by the ground-water, by atmospheric and telluric phenomena, such as heat, cold, storm, wind, barometrical and electrical changes.

The earth is constantly absorbing or emitting this ground-air: it is always loaded with moisture, and more or less impurity, being mixed with gases derived from the fermentation and decomposition of organic material in the soil. It may be laden with miasmatic, morbific agents, causing fevers and debilitating diseases. Therefore the purity of the ground-water and ground-air in the vicinity of a site intended for a dwelling is of the highest importance in their influence upon the health, comfort, and happiness of its occupants.

The site selected may be improved by grading to direct the flow of surface-water from the buildings, and by under-draining by means of tiles. The cellar should be drained by placing tile-drains outside, and lower than the foundation-walls. It should also be coated with a carefully prepared layer of cement-concrete, to keep air and dampness from entering the house from the earth; dryness of soil and air being the chief sanitary essential to be secured in selecting a site for a residence. Speaking upon this point, Dr. Henry I. Bowditch of Boston, who made the subject of consumption (in relation to its causes, and its prevalence in connection with influences derived from the soil) a subject of special investigation, says, —

"In choosing a site for a dwelling-house, the great desideratum is to obtain, not a perfectly *arid* place (for no such spot could be inhabited by man), but a portion of a township

which is neither so high as to be exposed to violent gusts of weather, nor so low that moisture will collect around it. Let it be on the side of a hill or plain, open to the south, and, if possible, defended from the north and east, — on a dry, porous soil, through which water freely percolates, and which, even after a rain, retains little moisture.

Dr. James Clark of England says, "Humid, confined situations, subject to great alternations of temperature between day and night, are the most dangerous. Of all the physical qualities of the air, humidity is the most injurious to human life; and therefore, in selecting situations for building, particular regard should be had to the circumstances which are calculated to obviate humidity, either in soil or atmosphere, in every climate.

"Dryness, with a free circulation of air, and a full exposure to the sun, are the material things to be attended to in choosing a residence."

The views of Dr. Bowditch were embodied in an address delivered before the Massachusetts Medical Society in 1862; and in the two following propositions is expressed the results of his investigations.

"First, A residence on or near a damp soil, whether that dampness be inherent in the soil itself, or caused by percolation from adjacent ponds, rivers, marshes, or springy soils, is one of the primal causes of consumption in Massachusetts, probably in New England, and possibly in other portions of the globe.

"Second, Consumption can be checked in its career, and possibly — nay, probably — prevented in some instances by attention to this law."

Subsequently Dr. Buchanan of England, knowing nothing of the investigations of Bowditch, proved that dampness of soil and consumption stood in relation to each other as cause and effect.

Drainage-works had been introduced into several English towns, rendering the soil dryer, and very greatly diminishing the mortality from consumption in proportion to the extent of subsoil dryness.

In Salisbury the death-rate from consumption fell forty-nine per cent; in Ely, forty-seven; in Rugby, forty-three; in Banbury, forty-one.

Under the direction of the privy council, Dr. Simon made an extensive and elaborate investigation of this subject; and he remarks, that "it confirms, without any possibility of question, the conclusion previously suggested, — that dampness of soil is an important cause of phthisis to the population living upon the soil."

In the Seventh Report of the Massachusetts State Board of Health, Dr. Winsor remarks, after investigating the drainage of a hundred and twenty-eight towns in Massachusetts, that "no observer can doubt that a large amount of preventable disease is caused by damp cellars."

The theory of soil-moisture as one of the active causes of consumption through the medium of the air is so confirmed by evidence from different parts of the world, that it may now be regarded as a well-established fact, *pregnant with a significance that cannot be over-estimated.*

Lord Bacon has said, "He who builds a fair house on an ill seat committeth himself to prison."

Air is essential to the life of all organized beings. It is composed of a somewhat changeable mixture of invisible gases. About twenty per cent of oxygen, seventy-nine per cent of nitrogen, and four-hundredths of one per cent of carbonic acid, constitute a normal atmosphere capable of sustaining vegetable and animal life, in so far as this life depends on atmospheric conditions.

Air is rendered impure from various causes. It carries odors, miasms, the gaseous products of animal and vegetable decomposition, dust, dirt, sand, saline matters, the pollen of plants, poisonous animal and vegetable exhalations, the germs of epidemic diseases (such as measles, scarlet-fever, and small-pox), and the varied products of combustion. Dead, confined, stagnant air becomes rapidly impure, and unfit for respiration. In nature, air is constantly kept in motion through the action of heat, cold, and electricity, and is purified by moving over large bodies of water, by diffusion and oxidation, storms and vegetation. Its most important constituent is oxygen, without which all organized beings would perish; while at the same time it is the most destructive agent in nature of all organic forms. It combines readily with all elementary bodies except fluorine.

An atmosphere of pure oxygen would be speedily fatal to

animal life ; so, also, would one of pure nitrogen, which is a gaseous body, having no affinity for animal tissues, like oxygen, and is incapable of being absorbed in respiration, though it is a constituent of all the tissues except the fatty, which are chiefly carbon. It dilutes the oxygen, renders it respirable, and modifies its destructive force. Carbonic acid is essential to plant-growth, but, when it is present in air in a high percentage, is speedily fatal to animal life by causing spasm of the larynx and consequent asphyxia. In its pure state it is irrespirable, and negatively poisonous.

We find it mixed with the deadly carbonic oxide in deep wells that have long been covered: and it has long been a custom with men who are about to descend into such wells to first lower a lighted candle, and, if it would continue to burn (showing the presence of oxygen), they would venture to descend; but this is no certain test that the air is safe, and fit for respiration, for life may speedily become extinct in an atmosphere in which a candle will continue to burn. The only safe procedure is to force fresh air into the well to displace the accumulated gases, before attempting to descend.

Carbonic-acid gas is pleasant and piquant to the taste, and agreeably cordial to the stomach.

Fuming champagne, sparkling cider, and the so-called soda-fountain, owe their agreeable qualities to this gas.

It is a product of the process of fermentation, is generated in yeast, is absorbed by the gluten of flour, which gives us, when properly kneaded and baked, the light, porous, spongy, well aerated bread of the skilful housewife. It issues from the earth in the vicinity of volcanoes, and from fissures in the rocks. It is generated in the bodies of men and animals by the destructive metamorphosis of tissue, and the processes of digestion, assimilation, and nutrition, and is excreted chiefly by respiration. It is one of the chief products of combustion, and is indispensable to vegetable growth. It is found in high percentage in soils, in the air of close bedrooms, halls, schoolhouses, shops, and churches that are occupied and poorly ventilated.

Surrounded by climatic influences too severe for endurance, we are obliged to enclose a small space or portion of air for a habitation, to shelter, protect, and make us comfortable.

For seven months of the year we must resort to artificial means of warming the air of our dwellings.

It is essential to the comfort of a pleasant home that the entire of the house should be warmed, — halls, living and sleeping rooms, — it being just as healthy to live and sleep in a warm as a cold room (and far more comfortable), good abundant ventilation being always secured.

In the "olden times," the spacious open fireplace, set in a huge chimney, with its roaring wood-fire, served to warm the living-room, and secure excellent ventilation. The sleeping-rooms, being unwarmed, were, in severe weather, cold, and uncomfortable to the last degree.

The old fireplace and hearth-stone have been torn out, a small chimney built, and the air-tight stove for wood or coal has taken its place, to heat, not warm, the room; to prevent, not secure, ventilation, especially when aided by double windows. Hot-air furnaces (a modified form of hot air-tight stove), hot water circulating through pipes, and steam, which are essentially alike in their operation, are now used to warm our best and most comfortable dwellings.

No device for warming is so cheerful, agreeable, and so healthy, as the open stove, grate, or fireplace, and none so expensive to maintain. The Galton stove is, perhaps, a more excellent arrangement, and more economical.

Next comes the furnace, which, when properly constructed with tight joints to prevent the escape of the poisonous coal-gases, and when freely supplied with fresh air and water for evaporation, does very well; but undoubtedly the very best, most safe, cleanly, and powerful heating apparatus is a low-pressure steam-boiler with direct or indirect radiation.

Whatever may be the sources of artificial heat, it is essential to the purity and healthfulness of our houses that ventilation and renewal of the air be secured by night and day. For this purpose the most simple devices that will use or control the forces of nature are the best.

Chimneys should be built in two compartments of suitable size, smoothly plastered on the inside, — one for the products of combustion; the other, for ventilation. The cellar, and every living and sleeping room in the house, should have openings at the top of the room leading into the ventilating-shaft, regulated by registers. Heat from fires and smoke

will warm the air in ventilator, and produce a strong upward current: at the same time, air as fresh and pure as can be obtained may be admitted from out of doors, sufficient to furnish each occupant of a room with from fifteen hundred to two thousand feet per hour, or in sufficient quantity to keep the inside free from impurities that can be detected by the senses of those who may enter the room from the outside open air.

This may be accomplished, in such a manner as to avoid disagreeable and dangerous currents, by lowering the upper sash of the window, having a thin, narrow strip of board so attached as to direct and diffuse the inflowing current through the upper air of the room; or the lower sash may be raised three inches, and a piece of board or thick stuff fitted to fill the space under the sash: this will allow air to enter freely through the opening at the middle of the window, with an upward current. An additional supply can be secured by having the thick piece of lumber used to fill under the sash so made as to project an inch and a half inside the lower border of the sash; then perforate with three-fourths inch augur-holes bored horizontal from the outside nearly through to meet perpendicular holes from the inside opening just within the sash. A slide can be adjusted to close the openings, when desired, and the style of construction and workmanship widely varied to suit individual notions.

These devices, though simple, are very effective. The inflowing currents are given an upward direction, and so broken as to prevent discomfort, annoyance, and danger from taking cold.

To maintain a temperature at sixty-five or seventy, with such a constant renewal of the air, will require a larger expenditure for fuel: so the question of ventilation and pure air often resolves itself, in the mind of a calculating Yankee, into one of dollars and cents; and he will question and doubt the expediency, economy, and necessity of the outlay, and neglect or refuse to secure for his family the blessings of this sanitary essential, pure air.

Very likely he will put on double windows, and fill up every crack admitting fresh air, heat one living-room with a close iron stove, and wonder why his wife should suffer so constantly with headache and nervous irritability, — weak,

peevish, pale, cross, and unsocial, — and his children be so tormented with colds, coughs, fevers; unable to bear the least exposure without illness of some kind; growing puny, sickly, unpromising, deficient in physical vigor, mental activity, energy, and courage; often requiring the services of the family doctor, with the disagreeable resources, appliances, comforts, and blessings of his mysterious art.

The wife and daughters, being more confined in-doors, suffer more than the father and sons. Then secure for their health, comfort, and happiness a home made comfortably warm in every part, filled with pure air, and made cheerful with glowing sunlight; supply a varied diet of substantial food, and clothing ample for protection; and they will need no iron for the blood, to keep the roseate tint of health on cheek and lip; no tonic for a weak stomach, poor appetite, impaired digestion; no artificial support for weak shoulders and crooked spines: study, exercise, and work will be to them a delight and recreation.

The consequences of breathing impure, stagnant, dead air, contaminated by respiration and bodily exhalations, are hardly understood, and but little appreciated in the community.

As stated by Dr. Parkes, "A man ordinarily gives off from twelve to sixteen feet of carbonic-acid gas in twenty-four hours by respiration, and an undetermined quantity by the skin.

"There is often exhaled from skin and lungs, in the form of vapor, from twenty-five to forty ounces of water, requiring two hundred and eleven feet of air per hour to maintain it in a state of vapor. The amount of organic matter has never been accurately ascertained; but it has been estimated at thirty grains per day for an adult. That from the lungs will darken sulphuric acid, decolorize a solution of permanganate of potash, and renders pure water offensive. . . . Collected on the surface of a globe containing ice-water, it is glutinous and sticky, having a disagreeable smell. It is precipitated by nitrate of silver, blackens platinum, yields ammonia, and albuminoid ammonia when distilled with the alkaline permanganate, as stated by Wanklyn, a German chemist, and is therefore nitrogenous. . . . It will attach itself to the walls of a room, and to furniture. It is absorbed by clothing, carpets, damp paper, and other substances, and

is very slowly oxygenized." The woman who cleans the house and washes the clothing understands the filthy nature of the exhalation.

Its presence in any considerable quantity is readily detected by the sense of smell whenever we enter, from the open air, occupied halls, school-rooms, shops, living-rooms, sleeping-rooms, that are not properly ventilated. Its ill effects upon animal and human life have been often demonstrated by experience and experiment.

Witness the oft-quoted horror of the black hole in Calcutta, where, in a room eighteen feet square, with only two small windows, a hundred and forty-six Englishmen were confined at eight o'clock in the evening (at six the next morning, all but twenty-three were dead); and the account of the steamer "Londonderry," where a hundred and fifty passengers were confined in a small cabin for several hours, the deaths amounting to seventy; and the prison, where, after the battle of Austerlitz, three hundred Austrian prisoners were confined (two hundred and sixty of them died very speedily).

"In all these instances death was caused, not by excess of carbonic acid, but by excess and concentration of animal exhalations, and a deficiency of oxygen."

Gavarret and Hammond have experimented repeatedly with animals, removing the watery vapor and carbonic acid, leaving the organic matter alone, and have conclusively proved that this organic matter is highly poisonous, and may be speedily fatal.

Evidence on this point is cumulative and conclusive. The records of jails, prisons, ships, hospitals, and armies, wherever men have been confined in large numbers in close, ill-ventilated quarters, always show the same results.

Such being the effects of breathing an air thus highly vitiated, it is clearly apparent that the continuous breathing in our homes, of an air rendered moderately impure from organic exhalations, must injuriously affect the health of those subject to its influence; and common observation and experience confirms this as true.

Such persons are troubled with headache, neuralgia, debility, weak digestion, faulty assimilation, impoverished blood, impaired nutrition of nerves and muscles, and consequent loss

of normal nervous energy, and that cheerful, hopeful spirit necessary for efficient activity and the highest possible attainment of success and happiness in life.

Besides these general effects of impure air, its relation to specific diseases is important, considered as a cause which is most fully proved.

Scrofula, the great enemy of all civilized races, in its many forms, arises from several causes acting upon the individual, such as hereditary predisposition, syphilis, scant clothing, poor food, cold, heat, dampness, uncleanliness, and excesses of every kind; but over all these, in importance, stands impure air, for these other causes may often be controlled or obviated. This cause, aided by one or more of these coincident conditions, is recognized all the world over as potential in the production of consumption, bronchitis, and pneumonia; and the popular belief that these diseases are caused by exposure to the weather, and changes in temperature, is not altogether correct, for there is abundant evidence to show that this cause is subordinate to several others.

Again: it has long been considered that an atmosphere, vitiated by the organic vapors and particles given off from the person, in addition to these effects that have been mentioned, favors the more rapid spread, and increases the virulence, of acute, infectious diseases, such as scarlet-fever, small-pox, measles, typhus, and the plague.

The exudations from the sick load the air of the sick-room with a vast amount of organic matter most injurious to breathe, increasing the severity of the disease, and retarding convalescence in all conditions attended with a febrile movement.

In hospitals, when a certain degree of contamination is reached, erysipelas and hospital-gangrene appear to condemn existing sanitary conditions; for these diseases never occur when men are treated in tents in the open air.

An abundant supply of reasonably pure water, for drinking, cooking, cleanliness of person, clothing, and habitation, is another sanitary essential of the home and farm.

Good potable water, when examined in a glass, should be limpid, colorless, odorless, and tasteless. Absolutely pure water is not found in nature: it is obtained only by distillation, is flat and insipid in taste, and not suitable for drinking, unless aerated, or made to absorb air.

Water covers three-fourths of the surface of the earth. It is an essential constituent of soils and almost all mineral substances, being present in the form of water of crystallization. It is indispensable to animal and plant life, constituting from twenty to ninety-nine per cent of their substances, and about three-fourths of the weight of man and animals. It is chemically formed by a union of two gases (hydrogen and oxygen), and is a peroxide of hydrogen, or hydrogen oxide.

Water is the great diluent and solvent in the vast laboratory of nature, and is essential to every chemical and vital change modifying the action of these forces, which are constantly at work upon and within all atoms of matter, modifying their arrangement, their mutual relations, and producing all the diversified phenomena with which we are acquainted.

Water is in constant motion, — a condition essential to the freshness and life of both water and air. Evaporated by wind and solar influence, it loads the atmosphere with its vapors, which, condensed, form clouds, and is precipitated on land and sea, in rain and snow, or hail. That, falling upon the earth, flows over its surface, or percolates more or less deeply into its strata, to emerge again, forming springs, ponds, brooks, and rivers, which flow in ceaseless currents to the sea; so that the rivers are never empty, and the sea is never full.

Water for house and barn may be obtained from rain, brook, river, spring, and from the earth by digging a well.

Rain washes out and dissolves the impurities of the atmosphere; such as, dust, organic matter, living and dead infusoria, the products of combustion, the gases of the air, oxygen, nitrogen in the form of ammonia, carbonic acid, and other matters.

When used for domestic purposes, it must be stored in reservoirs, and carefully filtered. They should be built under ground, of sufficient capacity to hold an abundant supply, with walls of brick laid in cement, the space between earth and wall filled either with clay or earth, carefully puddled in with plenty of water. A well of brick, laid in cement, should be built in the centre, with openings at the bottom to admit the water. Animal charcoal may be placed in sufficient quantity outside the base of the well, and the remain-

der of the cistern filled with clean sand free as possible from organic deposits.

The water, collected from the roof of house or barn, percolates through the sand to the central well, from which it may be pumped. Thus filtered, it is very free from impurities, is soft, clear, and potable. Such a cistern can be readily cleaned, and the sand renewed.

Another excellent method is to build in the same manner, in form of a jug, with a manhole in the top, and a partition of soft burnt bricks laid in cement separating it into two compartments. The water is delivered into one, is filtered through the porous brick partition into the other in a good state of purity. Such a cistern should be frequently cleansed, and the filtering-wall rebuilt with new bricks.

A house forty by twenty, with a rain-fall of forty-one inches, will furnish an average of sixty-five gallons a day. Other methods of filtration may be used, but these are the most simple, cheap, and efficient. Rain-water stored in open wood or lead-lined cisterns is often very impure, and highly poisonous, — fit only for washing-purposes.

Brook and river waters are often used. They are modified in quality by the ground from which their waters percolate, or over which they flow, whether gravelly, marshy, or clayey. They may hold in suspension or solution mineral or vegetable substances, or may be quite pure and suitable for use. An examination of their sources, their liability to become contaminated, and their sensible properties, is usually sufficient to determine their purity.

The waters of ponds, either natural or artificial, if fed by streams of abundant volume (unpolluted by sewage, the wash of cultivated fields, and the refuse of manufactories), if resting on a rocky, gravelly bed, and so deep that the sun cannot warm the underlying earth sufficient to cause fermentation, and stimulate vegetable growth to any great amount, are as pure and fit for domestic use as any that can be obtained.

The only objection to the use of such water is its warmth in summer, and consequent insipidity, which may be corrected by ice, and its liability to be affected by certain vegetable growths which render the water offensive to both taste and smell.

Spring-waters may be pure or impure. Their character is

determined by the nature and composition of the rocks over which they flow, and the soil or earth through which they filter. They may be tasteless, odorless, and colorless, and yet be so highly charged with carbonates of lime and magnesia, and other saline compounds, as to be unfit for domestic purposes.

In Massachusetts the underlying rocks are granitic, and the minerals, quartz, mica, felspar and iron.

The springs are generally pure, cool, and healthful, except in some localities where iron is found, where they may be so highly charged with the iron salts, the carbonates, sulphates, or sulphurets, as to be hard, brackish, and unfit for use.

An inspection of the rocks in the locality, and the deposits on the ground over which they flow, is usually sufficient to indicate their nature. With us, water from a pure, clear, cool spring, having a steady, abundant flow, both in summer and winter, is highly prized for domestic and farm purposes.

From time immemorial, all races of men, even nomadic tribes, have obtained their water-supply chiefly from the earth by digging a well. The advice of a dying Arab chieftain to his son, who asked what he should do to bless his tribe, was, "Dig a well."

In that land of arid plains and sandy deserts, the old patriarch of a restless, wandering Arab tribe understood the value, comfort, and blessing of a good well of water. No such admonition is needed in our times, when almost every house outside of cities has its well, from which domestic wants are supplied.

To us as a people the Scripture of ancient times may be applied with truth: "For the Lord thy God bringeth thee into a good land, a land of brooks of water, of fountains and depths that spring out of valleys and hills. . . . I will open rivers in high places, and fountains in the midst of the valleys: I will make the wilderness a pool of water, and the dry land springs of water."

After digging a well, "Then Israel sang this song, Spring up, O well; sing ye unto it: the princes digged the well, the nobles of the people digged it, by the *direction of* the law-giver, with their staves."

Water in the earth is supplied from rain-fall, which is modified in its quality by the soluble materials and gases

which it absorbs in its descent through air and earth to reach its level. It will therefore vary in purity. It may be fresh or saline, hard or soft, free from or loaded with organic or inorganic impurities, suitable for the use of man, or so polluted as to be dangerous to health and life. It is purified by percolating through sand and gravel, and by oxidation. It moves through the earth in currents, varying in velocity by obstructions presented by the different physical conditions it encounters in its course to the sea.

Its probable purity can be generally ascertained by examination of the soil, rocks, and wells in the vicinity.

If necessary, pits may be dug to expose the character of the underlying strata for inspection. If gravelly, and free from alluvial deposit-sand mixed with clay, infiltrated with vegetable products, and free from soluble inorganic materials derived from the disintegration of limestone and ferruginous rocks, and if the locality can be protected from an influx of surface-water, and pollution by filth, a well may be sunk to below the level of the ground-water, that will afford an abundant supply, suitable for house and farm purposes, which will yield for centuries its pure life-giving treasure to generation after generation, who will

> "Find it the source of an exquisite pleasure,
> The purest and sweetest that Nature can yield."

From whatever source our water-supply is obtained, convenience requires that it should be conducted through pipes and conduits to the place of use at house and barn. These may be made of wood, cement, earthen-ware, lead, block tin, iron, gutta-percha, and other materials.

The well-sweep and "old oaken bucket" of our fathers has been supplanted by the more convenient pump of wood, copper, or iron. The aqueduct made of logs, to bring the waters of the hillside spring or brook, has been exchanged for pipes of lead, iron, or earthen-ware.

We should be careful not to lose in purity of supply, by our new methods, what we gain in permanence, and economy of outlay. Of all materials used for conduits, lead is the most dangerous to health and life.

Pure soft water, and waters charged with carbonic acid, the chlorides, nitrates, sulphates, and organic matters, act

rapidly on lead. Some of these agents coat the pipe with compounds insoluble in water, which may be worn away by the friction of the current, and slowly poison by its cumulative action those who may drink the water. People are not susceptible alike to the influence of lead. So small a quantity as the hundredth of a grain to a gallon has been known to cause paralysis, showing the subtle and dangerous character of the poison.

Lead can be used for short service-pipes with comparative safety, if the water is allowed to run freely before using, and for shallow wells, if the pump is vigorously used to wash out the water that has stood for a time in the pipe. It is better, however, to dispense with its use entirely, and substitute iron, which is never harmful, and only objectionable on account of its tendency to oxidation, which may be overcome for a long time by dipping the pipes, while hot, in a bath of coal-tar and coal-rosin.

It has been proposed to coat the interior of lead pipe with block tin, a soft metal. Experience has not proved its practical utility.

The use of earthen, glazed stone-ware pipe for aqueducts, laid with cement joints, is an excellent method to preserve the purity of the water. It is clean, durable, and, in many localities, as good as iron.

Water may be purified, when necessary, by distillation, boiling, aeration, filtration, and by the addition of chemical agents that are harmless, like alum, lime-water, charcoal, and weak vegetable infusions that hold tannin in solution.

Boiling expels the air, carbonic acid, carbonate of lime, a part of the iron, and acids, and kills the microscopic infusoria, bacteria, vibrios, and plant-life, that abound in most natural waters. Household purification is best effected by the simplest methods, such as boiling, and filtration through sponge, cotton-flannel, and tap-filters filled with quartz-sand and animal charcoal.

There are many devices invented that are excellent filters; but the best method is to secure water that needs no purification, if possible.

Water in the form of ice is both a luxury and a necessity with most families, — a luxury in the hot months by cooling

our beverages; a necessity to preserve sweet and wholesome our perishable articles of food, and to assist the sick.

Many people believe that ice is always pure; that, in freezing, water is cleared of its impurities: which is partly true, as ice is always more pure than the water from which it forms. But there have been repeated outbreaks of sickness caused by ice taken from the surface of stagnant ponds containing large quantities of decomposing organic deposit: therefore we should be careful to secure our ice-crop from only pure sources.

An account of the outbreak of sickness in the summer of 1875, at Rye Beach, caused by impure ice, as given by Dr. A. H. Nichols in the Seventh Report of the Massachusetts Board of Health, is worthy of attentive, careful perusal.

We can ask the chemist to ascertain, by the manipulations and tests of his wonderful art, the nature and degree of impurity present in water. He will find the inorganic matters held in solution, or suspension, and determine with con siderable certainty the organic impurities, as indicated by the nitrogen, ammonia, and albuminoid ammonia; but that indefinable unknown entity, miasm, or germ, which often pollutes water, to spread disease and death among those who drink it, eludes his search, and defies his re-agents, so that he cannot detect with positive certainty, in many instances, a dangerous pollution of water.

John Wesley remarked, "Cleanliness is second only to godliness;" and Mohammed, that "the practice of religion is founded on cleanliness, which is one-half the faith, and the key of prayer."

To these wise sayings let us add the aphorism of Hippocrates, the father of medicine: "Pure air, pure water, and a clean soil."

Cleanliness of the soil claims attention as one of the important sanitary essentials of the home and farm.

How to dispose of household waste, dirty slops and sink-water, human and animal excrement, so as to prevent a nuisance and preserve air and water supply from pollution, is a problem that has taxed the wisdom of wise men since the days of Moses.

Our fathers built their houses convenient to the highway, over cellars dug deep in the earth, drained of surplus water

by a stone culvert passing out of one corner to a low spot outside, affording a convenient sally-port for rats and cats, muskrats and polecats.

In this cellar, the root-crops, apples, cider, and household supplies were stored in the autumn, each giving off its own peculiar odor, increasing in pungency with advancing decomposition as spring approached.

In the centre was built the huge chimney, large enough to afford a fireplace of ample dimensions in the rooms above. The only means of ventilation was by opening the cellar-door, and, upward through floors and partitions to the open air, through fireplaces and chimney.

A pipe conveyed the dirty sink-water just outside the walls of the house, to be absorbed by the earth, or diffused over its surface. Near by was the well, ten, twenty, or thirty feet deep, fed by draining water from the adjacent earth.

Not far from house and well, an independent building of small dimensions, plain in architectural design, was erected, or else a peculiarly ornamental annex was built out from the wood-house, for a privy.

The deposits, being received into a shallow pit, were allowed to spread over the surface of the ground, diluted with every rain; or perhaps once a year the putrefying mass was carted off for fertilizing-purposes. Near by was placed the pig-pen, the yard of which was another pit (perhaps one or two feet deep) filled with semi-fluid filth emitting odors most disagreeable and indescribable.

The barn was often built on higher ground than the house. The cattle-yard, or barn-yard, received the chief solid and liquid excrements of the cattle. Its surface was concave, so that after a rain its lowest or deepest part was a filthy, dirty pool, foul smelling, covered, under solar influence, with green slime. Sometimes the water was conveyed by a shallow ditch to the surface of an adjoining field, to infiltrate the soil in all directions with its filth. Such insanitary conditions may be found too frequently in every town and village. Therefore, if what has been said is correct, concerning the purity of the air about and under our dwellings, and the purity of the ground-water when used for drinking-purposes, such accumulation of filthy materials in the soil must con-

taminate both air and water, and injuriously affect the health of our people. And it is an important "sanitary essential of the home and farm," that the soil in the vicinity of a home should be kept clean, and free from filth-pollution of every kind.

We cannot explain the immunity from disease that has often been observed in families living in such surroundings as have been described, except that Nature, by her chemical processes, is constantly converting noxious elements into new, harmless combinations, and, by solar influence and plant-growth, so relieving the soil of impurities as to prevent that degree of concentration of poisonous elements which would breed disease and death (diffusing, and so diluting, by atmospheric currents, the noisome, sickening, gaseous exhalations of a filth-sodden, filth-polluted, fermenting soil, as to destroy their power to injure); or else the wonderful power of tolerance, resistance, and accommodation, when brought gradually under the influence of morbific agencies possessed by the nerves, fluids, and tissues of our bodily organization, protects the health and life. Fortunately, these dirty, filthy conditions do not directly produce deadly epidemic or infectious diseases: they furnish the nidor, — the material for the multiplication and diffusion of that miasm or germ, that unknown morbific agent specific in nature and power, coming through the medium of air and water, and of unknown origin, which must be added to cause "the pestilence that walketh in darkness, and the destruction that wasteth at noonday."

The perfect house will not be built until the perfect architect, carpenter, mason, and plumber, work together in its construction. Wall-paper, carpets, and upholstered furniture will be condemned by the best maxims of sanitary science.

No house is complete in essential comforts, and arrangements for personal cleanliness, without a bath-room, supplied with hot and cold water, a bath-tub, wash-basin, and water-closet. These should be of the simplest possible construction, avoiding all complicated patent contrivances, connected with a thoroughly trapped and ventilated iron soil-pipe, well and securely placed, which may receive the sink-water, and discharge outside of the house into a well-ventilated stone-

ware sewer-pipe, to be conveyed to the place for its final disposal.

That all excreta and kitchen-water should be promptly removed from the vicinity of the house in such a manner as to prevent contamination of earth, air, and water, is apparent to every one.

How this can best be accomplished without creating a dangerous nuisance depends on such varied local considerations, that it is evident that no one method can be applied to all places.

The safest and most efficient system is that of water-carriage, when carefully arranged and thoroughly constructed, discharging through impervious pipes into a well-built public sewer.

In rural neighborhoods, and for isolated houses, this is impossible; and some other means for the disposal of the sewage must be devised. Some resort to the dangerous cesspool, or filth-storehouse: others pour it into the nearest brook or water course, or else allow it to flow over the surface of a side-hill at some distance from the house. All these methods are disagreeable, objectionable, and often dangerous.

The most perfect device yet invented is that of intermittent subsoil filtration with Field's Patent Flush Tank, as improved by Col. E. G. Waring, jun., of Newport, a distinguished sanitary engineer, and described in his work on the "Sanitary Drainage of Houses and Towns," and applied by him to dispose of the sewage of the town of Lenox, that of the prison for women at Sherborn, and that of many private houses.

Another excellent method of disposing of the excreta is by the liberal use of dry earth, and its frequent removal. The modern earth-closet, the invention of the Rev. William Moule, is one form of this system.

The sanitary essentials discussed in this essay apply to both barn and house. No farmer can neglect them, and secure the highest attainable degree of health and comfort to, and profit from, his stock.

Pure air, pure water, cleanliness, with good food and gentle, kind care, are essential to the success of the dairy farmer who would secure the largest possible product of rich,

sweet milk for butter and cheese, or supply his patrons in town and city acceptably with this choicest, richest, most important, and valuable of all natural foods, and the most sensitive also.

Many diseases of cattle, sheep, swine, and horses are greatly aggravated, if not directly caused, by bad sanitary surroundings and conditions.

A teamster at Miller's Falls lost several horses by disease. He asked his physician what he thought was the cause. The young man examined his stable, and advised him "to break the door all to pieces," as that was the cause of the sickness, by keeping out fresh air. The man lost no more horses.

A farmer lost yearly one or more fine shotes, kept in a certain close, damp, dark pen; while in another pen, open to fresh air and sunlight, a hog was never known to be sick. A *post-mortem* examination showed that these hogs died of consumption, caused by breathing damp, impure, stagnant air, and by the absence of sunlight: the conditions were changed, and no more hogs died, showing that even a hog cannot bear every unhealthy influence, added to the filth in which he will wallow in hot weather to cool himself.

Rossignol, a French writer, states "that previous to 1836 the mortality of French cavalry horses varied from a hundred and eighty to a hundred and ninety-seven per thousand per annum. They enlarged the stables, and increased the quantity of the ration of air, and reduced the loss in the next ten years to sixty-eight per thousand per annum."

In the Italian war of 1859, M. Moulin, chief veterinary surgeon, kept ten thousand horses many months in barracks open to the external air, in place of closed stables. Scarcely any horses were sick, and only one case of glanders occurred.

Wilkinson, an English writer, says, "that the annual mortality of cavalry horses, formerly very great, is now reduced to twenty per thousand, of which one-half is from accidents and incurable diseases. Glanders and farcy have almost disappeared; and, if a case occurs, it is considered evidence of neglect.

Our subject embraces a wide range of investigation concerning matters fundamental to the health, comfort, and happiness of our people and our domestic animals. As we study, understand, and appreciate the conditions that envi-

ron us in nature, the harmonious operations of those forces and agencies, acting upon and within us, which make the mystery of life possible, and which, if not understood and controlled, bring suffering, disease, and death, we are engaged in a work that has taxed the energies and brains of many of the wisest and best men that have ever lived on the earth. Although much is known, yet that silent, unseen force, that evolves the phenomena of life, eludes the search of the wisest philosopher. The secret of life has never been discovered or revealed.

The microscope shows its wonderful work in cell and protoplasm, and human power can go no farther.

If the statements and suggestions of this essay have the approval of your intelligent judgment, stimulating your thought, and prompting you to protect your homes more carefully from morbific influences, and secure for yourselves, your families, and domestic animals, the pure air, pure water, and cleanliness that God has blessed, for the preservation of health and life, then this passing hour will be remembered with pleasure, in which we considered some of the sanitary essentials of the home and farm.

At the close of the reading, Mr. Wilder led in an interesting discussion of the subject presented. The thanks of the Board were unanimously voted to Dr. Lynde.

On the motion of Mr. Wilder, the Board discussed the recommendation of the Governor in regard to the establishment of scholarships at the Agricultural College by the county societies: the matter was laid on the table.

Professor Goessmann presented his Ninth Annual Report on Commercial Fertilizers.

NINTH ANNUAL REPORT ON COMMERCIAL FERTILIZERS.

BY PROFESSOR C. A. GOESSMANN.

The consumption of commercial fertilizers is still increasing from year to year throughout the entire country. The tendency of a gradual but steady rise in the cost of various kinds of crude stock used for their manufacture (referred to in my last annual report, 1880–1881) has been a noticeable feature in the history of the trade in fertilizers during the past year. The prices of the potassa, and of the nitrogen in particular, have been higher than in previous years; whilst those of the different forms of phosphoric acid have remained, as a general rule, more stationary. The higher grades of potassium chloride (muriate of potash) have brought a higher price; whilst the kainits, and the higher grades of potassium sulphate, have been sold at previous rates, or for less. A continuation of this condition may have its effect, in the future, on the composition of the compound fertilizers, to meet their customary retail market-prices, per ton, by lowering their nitrogen percentage, and increasing that of phosphoric acid. The lately reduced importation of genuine Peruvian guano, as well as the smaller supply of Menhaden fish refuse, has no doubt exerted a serious influence on the entire trade, and may, in part at least, account for the increased cost of all our ammoniated superphosphates. I have taken particular pains to obtain at various times during the past year, until quite recently, reliable market reports from Boston and New York. A digested abstract of the information obtained in this connection will be found within the subsequent pages, under the heading, "New-York and Boston Market-Prices for 1881." The figures given in that price-list refer, in either case, to the cost of the articles delivered at the respective local railroad depot, in case of cash payments. As the cost of distribution, including the customary credit of from three to six months, must vary more or less in each case, it has, for obvious reasons, been left to the good judgment of the consumer to decide whether, in his own locality, the price asked for the fertilizer he bought is a fair one. According to the best information obtained, it seems quite admissible, to expect in the retail trade, in the majority of instances, an

advance of from twenty to twenty-five per cent above first cost at the works.

The valuation which accompanies, in many instances, the analysis of the fertilizer, does not necessarily coincide with that of the manufacturer, but simply approximates the price at which the various constituents named in the analysis were offered for sale in a good form in the general market at the time of collection.

During the past year, and for the earlier period of the coming season, the following prices may be considered a fair basis for the valuation of the essential constituents of fertilizers (only *specified* forms of the *guaranteed composition* have received a particular consideration in the valuation); and, in case of inferior mechanical condition of the fertilizers, the customary lower rates have been adopted.

	Price per pound, in cents.
Nitrogen in form of nitric acid	25
Nitrogen in form of actual ammonia	26
Nitrogen in form of animal matter	24
Soluble phosphoric acid	12.5
Reverted phosphoric acid	9
Insoluble phosphoric acid	6
Potassium oxide in muriate of potash	5
Potassium oxide in kainit	5
Potassium oxide in high grades of sulphate of potassa	7

It is well for farmers to consider that the manufacturers are only obliged to furnish the lowest percentage guaranteed in their statements of composition, and that the insoluble phosphoric acid in many of our ammoniated superphosphates consists of fine-ground mineral phosphates, which are less efficient, and consequently of less worth, than that in form of bones and of animal and vegetable matter.

New-York and Boston Market-Prices for the Year 1881 (*March*).

I.

	Price per pound, in cents.
I. *Nitrogen.* In form of nitric acid	25
In form of ammonia	26
In form of dried ground meat and blood, finely-pulverized steamed bones, finely-ground fish-guano, Peruvian guano, urates, poudrettes, and artificial guano	24

	Price per pound, in cents.
Nitrogen. In form of finely-ground bones, and bat-guano	22
In form of fine-ground horn, wool-dust, etc.	15
In form of coarsely-ground bones	18
In form of horn-shavings and woollen rags, human excretions and barnyard-manure, fish-scraps, animal refuse-matter from glue factories and tanneries, etc.	12
II. *Phosphoric Acid soluble in water.* As contained in alkaline phosphates and superphosphates	12.5
In Peruvian guano and urates	9
In form of so-called reduced or reverted acid	9
In precipitated bone-phosphate, steamed fine bones, fish-guano, according to size and disintegration, from	6 to 8
In form of bone-black waste, wood-ash, Caribbean guano, ground-bone ash, coarsely-ground bones, poudrette, barnyard-manure, etc.	4
In form of finely-ground South-Carolina and Nevassa phosphates	3
III. *Potassium Oxide.* In form of muriate of potash or chloride of potassium	5
In form of sulphate of potassa in natural and artificial kainits	5
In form of higher grades of sulphate of potassa	7 to 7.5

II.

NAME OF MATERIAL.	Price per ton of 2,000 pounds, in dollars.	Price per pound in case of from 100 to 200 pounds, in cents.
Sulphate of Ammonia, containing from 24 to 25 per cent of ammonia	95–105	4.75–5.5
Nitrate of Soda (Chili saltpetre), containing 95 per cent of that compound	75–80	3.75–4.5
Nitrate of Potassa, containing 94 to 96 per cent of that compound	165–170	9–9.5
Dried Blood, yielding from:—		
(*a*) 15 to 17 per cent of ammonia (black),	65–75	3.5–4
(*b*) 12 to 14 per cent of ammonia (soft red),	55–60	2.75–3.25
(*c*) 10 to 12 per cent of ammonia	45–50	2.25–2.75
Dried Meat, yielding from 14 to 15 per cent of ammonia	50–55	3
Castor Pomace (ground), yielding 5 to 6 per cent of ammonia	25–30	1.5–2
Cotton-seed Meal, yielding from 7 to 8 per cent of ammonia	33–35	1.75–2.25
Fine-ground Bones (steamed), yielding from 3.5 to 4.5 per cent of ammonia, and containing from 50 to 55 per cent of bone-phosphate	38–45	2–2.5

NAME OF MATERIAL.	Price per ton of 2,000 pounds, in dollars.	Price per pound in case of from 100 to 200 pounds, in cents.
Bone-black (waste material), containing from 30 to 34 per cent of phosphoric acid .	30–35	1.75–2
South-Carolina Phosphate (ground), containing from 25 to 28 per cent of phosphoric acid	20–25	1.25-1.5
Navassa Phosphate (ground), containing from 25 to 28 per cent of phosphoric acid .	20–25	1.25–1.5
Canadian Apatite (ground), containing from 30 to 35 per cent of phosphoric acid .	30–35	1.5–2
No. 2 Superphosphate of Lime, containing from 15 to 16 per cent of soluble phosphoric acid	30–35	1.5–2
Acid Phosphate, containing from 12 to 14 per cent of soluble phosphoric acid . .	25–30	1.5-1.75
Lobos Guano, yielding from 4 to 6 per cent of ammonia, and containing from 18 to 20 per cent of phosphoric acid . . .	55–60	3–3.5
Peruvian Guano (guaranteed), yielding from 6 to 8 per cent of ammonia, and containing from 12 to 14 per cent of phosphoric acid,	60–65	3.25–3.5
Muriate of Potash, containing from 80 to 85 per cent of that compound, equal to from 50 to 53.7 per cent of potassium oxide .	42–45	3
Muriate of Potash (Douglasshall), containing 80 per cent of that compound, equal to 50 per cent of potassium oxide and about 10 per cent of sulphate of magnesia . .	45–50	2.5
Sulphate of Potassa, containing 80 per cent of that compound, which is equal to 43.3 per cent of potassium oxide . . .	65	4
Sulphate of Potassa, containing from 60 to 65 per cent of that compound, which is equal to from 32.3 to 35 per cent of potassium oxide	55-60	3.5
German Potash-Salt, containing from 28 to 32 per cent of sulphate of potassa, which is equal to from 15 to 17.3 per cent of potassium oxide	18–20	1.25
Kainit (low grade), containing 22 to 26 per cent of sulphate of potassa, which is equal to from 11.9 to 14 per cent of potassium oxide	12–15	.75–1
Sulphate of Magnesia (Kieserite), containing from 60 to 70 per cent of that compound,	20–25	1.25–1.5
Sulphate of Magnesia, containing from 50 to 55 per cent of that compound . . .	14–15	.8
Fine-ground Gypsum, containing from 95 to 98 per cent of that compound . . .	9–10	.5

Potash Compounds.

Muriate of Potash.

I.

(Collected of Messrs. Bagg & Batchelder, Springfield, Mass.)

	Per cent.
Moisture	2.00
Potassium oxide	50.40
Sodium oxide	4.99
Magnesium oxide	None.
Sulphuric acid	Trace.
Calcium oxide	None.
Sand, etc.	.40

II.

(Collected of Bowker Fertilizer Co., Boston, Mass.)

	Per cent.
Moisture	2.70
Insoluble matter, water	.40
Chlorides of alkalies	92.70
Potassium oxide	47.48
Calcium oxide	Trace.
Magnesium oxide	Trace.
Sulphuric acid	Trace.

III.

(Collected of Messrs. Brown & Warner, Northampton, Mass.)

	Per cent.
Moisture	2.00
Potassium oxide	50.54
Calcium and sulphuric acid	Traces.

IV.

(Sent on for examination.)

	Per cent.
Water	.80
Potassium oxide	49.83
Chloride of magnesium	Trace.
Sulphate of magnesium	Trace.

These four samples represent fairly the average quality, in our markets, of this valuable potash compound. The well-known reliability of this brand, aside from its comparative fair price, has caused its extensive application, and late rise from thirty-five to forty-five dollars per ton.

Potash-Magnesium Sulphate.

I.

(Collected of Bowker Fertilizer Co., Boston, Mass.)

	Per cent.
Moisture at 100° C.	2.70
Magnesium sulphate	32.76
Calcium sulphate	2.00
Potassium sulphate	45.50
Chlorine	None.
Insoluble matter	.60

II.

(Collected of Messrs. Brown & Warner, Northampton, Mass.)

	Per cent.
Moisture at 100° C.	5.75
Magnesium sulphate	37.02
Potassium sulphate	44.27
Sulphuric acid	46.99
Insoluble matter	.56

These two samples represent a brand of "German potash-salts" which is highly recommended for deep-rooting plants, as clover, beet-roots, etc., on account of the exceptional rapid diffusion of its potassa throughout the soil, in consequence of the presence of magnesium sulphate. The absence of chlorides renders it also the safer article for various special industrial crops, as tobacco, sugar-beet, and potatoes.

Ashes from Blue-Works.

(Sent by H. E. B. Waldron, New Bedford, Mass.)

	Per cent.
Moisture lost at 100° C.	12.74
Organic and volatile matter	36.22
Ash constituents	63.78
Insoluble matter	12.30
Potassium oxide (sulphate)	9.02
Cyan compounds	Traces.

The commercial value of this refuse article consists in its potassium oxide, which is present mainly in the form of sulphate. The peculiar origin of this material advises some precaution in regard to its use in a fresh state, as it may contain still some cyan and sulpho-cyan compounds which are known to be injurious to plant-growth. The moist crude material should be exposed to the air for some time in a

similar way, and for similar reasons, as the fresh refuse lime of gas-houses before applied. It would be of interest to learn the specific action of a well-aired article on pear-trees, on account of the large amount of oxide of iron it contains.

Logwood-Ashes (Boston Dye-Works).

(Collected of Messrs. Horton & Phelps, Northampton, Mass.)

	Per cent.
Moisture	1.50
Volatile matter	3.90
Total phosphoric acid	2.30
Calcium oxide	53.28
Magnesium oxide	Trace.
Potassium oxide	.08
Insoluble matter	9.70

The value of this recently introduced ash rests on its phosphoric acid, and its high percentage of lime. The wood which furnishes this ash had lost its potash by a previous abstraction of its coloring-matter.

Magnesium Sulphate.

I.

(Bowker Fertilizer Co., Boston, Mass.; collected of Massachusetts Agricultural College.)

	Per cent.
Moisture	23.70
Magnesium oxide	18.20
Calcium oxide	2.30
Sulphuric acid	37.22
Insoluble matter	7.55

II.

(Sent on for examination.)

	Per cent.
Water	7.50
Sulphuric acid	41.85
Magnesium oxide	18.26
Calcium oxide	2.18
Insoluble matter	.40

The superior fitness of this compound for the absorption of ammonia in place of gypsum has not yet received that attention which it deserves. Its action on stem and leaf growth in case of forage crops, as clover, also calls for home experiments in that direction.

Gypseous Shale (Port Byron, N.Y.).

(From Mr. Ellis, Amherst, Mass.)

	Per cent.
Calcium carbonate	11.05
Magnesium carbonate	2.65
Calcium sulphate	38.55
Iron and alumina	.60
Insoluble matter	37.15

This material has been sent on for examination, to ascertain its commercial value in our market. As its value depends largely on the gypsum present, it will be seen that the cost of transportation interferes with its sale at remunerative prices within our State.

Onondaga Plaster.

I.

(Collected of Messrs. Sheldon & Newcombe, Greenfield, Mass.)

	Per cent.
Moisture at 100° C.	12.65
Calcium oxide	30.20
Magnesium oxide	5.04
Iron and alumina oxides	1.60
Carbonic acid	8.60
Sulphuric acid	33.95
Insoluble matter	5.80

II.

(Collected of W. H. Earle, Worcester, Mass.)

	Per cent.
Moisture at 100° C.	14.35
Calcium oxide	31.46
Magnesium oxide	3.93
Iron and alumina oxides	1.30
Sulphuric acid	36.00
Carbonic acid	8.21
Insoluble matter	4.79

The Onondaga plaster has been sold (at six dollars per ton), during the past year, quite generally throughout the western and central parts of the State. It contains from sixty to sixty-two per cent of sulphate of lime, — about two-thirds of the amount in a good Nova-Scotia article, which supplied our entire want in previous years.

Marl.

(Sent by Hon. Elizar Smith, Lexington, Mass.)

	Per cent.
Moisture at 100° C.	55.80
Dry matter at 100° - 110° C.	44.20
Organic matter	3.44
Carbonate of lime	37.00
Carbonate of magnesia	.57
Oxides of iron and alumina, with traces of phosphoric acid	.70
Insoluble matter	2.49
Phosphoric acid and nitrogen	Traces.

This marl is noticeable on account of its deficiency in phosphoric acid and in magnesia compounds. Its superior mechanical condition renders it a valuable material wherever application of carbonate of lime is advisable.

Orchilla Guano.

(From Messrs. Horton & Phelps, Northampton, Mass.)

	Per cent.
Moisture	11.20
Organic and and volatile matter	–
Total phosphoric acid	18.11
Total calcium oxide	39.53
Insoluble matter	2.40
Magnesium oxide	Trace.

This sample, like those described in previous reports, represented in its natural condition a fine, pulverized material, which contained from thirty-nine to forty per cent of bone-phosphate. Its fitness for the incorporation in barnyard-manure, and direct application upon turfy lands, has been repeatedly pointed out.

Nitrate of Potassa.

(From Bowker Fertilizer Co., Boston, Mass.)

	Per cent.
Moisture	1.75
Potassium oxide	45.62
Calcium oxide and sulphuric acid	Traces.
Insoluble matter	Trace.

The above sample represents a good standard article of its kind, containing from ninety-five to ninety-six per cent of nitrate of potassa. The price of this chemical, which is from a hundred and sixty-five to a hundred and seventy dollars

per ton, is too high to recommend it for general farm purposes. For experimental purposes in fruit-culture, as a source of potassa and nitrogen, it deserves a careful consideration.

Sulphate of Ammonia.

(From Horton & Phelps, Northampton, Mass.)

	Per cent.
Moisture	1.50
Ammonia	27.00
Sulphuric acid	70.70
Insoluble matter	None.

This sample is of a good quality. The supply of sulphate of ammonia has been less in our market during the past year than in previous years. The price, which was formerly ninety dollars, has risen to a hundred and five dollars. It will be advisable for farmers to abstain from buying low grades — dark-colored articles — for experimental purposes on account of their doubtful character.

Wool-Waste (saturated with oil).

	Per cent.
Moisture at 105° C.	8.43
Nitrogen	6.25

Value equal to from sixteen to eighteen dollars per ton.

Bone Fertilizers.

I.

Ground Bones.

(Bowker Fertilizer Co.; collected of Mr. Minott, Westminster, Mass.)

	Per cent.
Moisture at 100°–110° C.	7.20
Organic and volatile matter	37.40
Ash constituents	62.60
Total phosphoric acid	26.17
Total nitrogen	4.01
Sand, etc.	.04

II.

Fine-ground rendered Bones.

(Edmund Hersey, Esq., Hingham, Mass.)

	Per cent.
Moisture 100° C.	4.00
Organic and volatile matter	26.40
Ash constituents	73.60
Total phosphoric acid	28.50
Nitrogen	2.60

III.

Darling's Fine Bones.

(Collected of Messrs. Parker & Gannet, Boston, Mass.)

	Per cent.
Moisture at 100°–110° C.	7.96
Organic and volatile matter	42.81
Ash constituents	57.19
Total phosphoric acid	23.09
Nitrogen	4.29
Insoluble matter	1.25

IV.

Pure Ground Bones of A. L. Amos.

(Sent by Mr. Preston.)

	Per cent.
Moisture at 100° C.	9.25
Organic and volatile matter	46.25
Ash constituents	53.75
Total phosphoric acid	20.61
Nitrogen	3.79
Insoluble matter	6.00

V.

C. W. Belknap & Low, Portland, Me.

(Collected of Rice Brothers, Worcester, Mass.)

	Per cent.
Moisture	8.070
Organic and volatile matter	46.950
Ash constituents	53.050
Total phosphoric acid	21.300
Nitrogen	4.698
Insoluble matter	.210

Animal Matter.

(Sent by Hon. J. B. Moore, Concord, Mass.)

I.

	Per cent.
Moisture lost at 100° C.	8.76
Organic and volatile matter	42.28
Ash constituents	57.72
Total phosphoric acid	21.62
Total nitrogen	3.61
Insoluble matter, sand, etc.	.54

Valuation per ton of two thousand pounds: —

432.4 pounds of phosphoric acid	$25 94
72.2 pounds of nitrogen	17 33
	$43 27

II.

	Per cent.
Moisture lost at 100° C.	17.36
Organic and volatile matter	53.02
Ash constituents	46.98
Total phosphoric acid	11.50
Total nitrogen	1.74
Insoluble matter	7.30

Valuation per ton of two thousand pounds: —

230 pounds of phosphoric acid	$13 80
34.8 pounds of nitrogen	8 35
	$22 15

Darling's Lawn-Dressing.

(Collected by Messrs. Parker & Gannet, Springfield, Mass.)

	Per cent.
Moisture	9.58
Organic and volatile matter	41.39
Ash constituents	58.61
Nitrogen	3.15
Total phosphoric acid	14.62
Potassium oxide	7.02
Soluble phosphoric acid	1.39
Reverted phosphoric acid	4.16
Insoluble phosphoric acid	9.07
Insoluble matter	1.00

Valuation per ton of two thousand pounds: —

27.8 pounds of soluble phosphoric acid	$3 47
83.2 pounds of reverted phosphoric acid	7 49
181.4 pounds of insoluble phosphoric acid	10 88
63 pounds of nitrogen	15 12
140.4 pounds of potassium oxide	7· 02
	$43 98

Riverside Superphosphate.

(J. O. Whitten, Cambridge, Mass.; collected of George Upton, Esq., Boston, Mass.)

	Per cent.
Moisture at 100°–105° C.	6.70
Organic and volatile matter	49.30
Ash constituents	50.70
Total phosphoric acid	18 13

	Per cent.
Soluble phosphoric acid	1 50
Reverted phosphoric acid	4.13
Insoluble phosphoric acid	12.60
Nitrogen	3.60
Insoluble matter	1.40

Valuation per ton of two thousand pounds: —

30 pounds of soluble phosphoric acid	$3 75
82.6 pounds of reverted phosphoric acid	7 43
252 pounds of insoluble phosphoric acid	15 12
72 pounds of nitrogen	17 28
	$43 58

Animal Fertilizer.

(Messrs. Whittemore Brothers, Wayland, Mass.; sent on for examination.)

	Per cent.
Moisture at 100° C.	6.50
Organic and volatile matter	32.96
Ash constituents	67.04
Total phosphoric acid	12.65
Soluble phosphoric acid	1.25
Reverted phosphoric acid	2.77
Insoluble phosphoric acid	8.63
Nitrogen	2.73
Potassium oxide	7.24
Insoluble matter	5.36

Valuation per ton of two thousand pounds: —

25 pounds of soluble phosphoric acid	$3 12
55.4 pounds of reverted phosphoric acid	4 99
172.6 pounds of insoluble phosphoric acid	10 36
54.6 pounds of nitrogen	13 10
144.8 pounds of potassium oxide	7 24
	$38 81

Bowker's Animal Fertilizer.

(Collected of Mr. William H. Earle, Worcester, Mass.)

	Per cent.
Moisture	10.33
Organic and volatile matter	49.93
Ash constituents	50.07
Total phosphoric acid	11.99
Soluble phosphoric acid	4.78
Insoluble phosphoric acid	2.18
Reverted phosphoric acid	5.03
Nitrogen	3.79
Potassium oxide	4.84
Insoluble matter	5.57

Valuation per ton of two thousand pounds: —

95.6 pounds of soluble phosphoric acid	$11 95
100.6 pounds of reverted phosphoric acid	9 05
43.6 pounds of insoluble phosphoric acid	2 62
75.8 pounds of nitrogen	18 19
96.8 pounds of potassium oxide	4 84
	$46 65

Dried Ground Fish.

(Preston Fertilizer Co.; collected of Messrs. Spaulding & Co., Northampton, Mass.)

I.

	Per cent.
Moisture	27.20
Organic and volatile matter	64.65
Ash constituents	35.35
Total phosphoric acid	8.32
Nitrogen	4.22
Potassium oxide	.80
Insoluble matter	1.74

Valuation per ton of two thousand pounds: —

16 pounds of potassium oxide	$0 80
166.4 pounds of phosphoric acid	9 98
84.4 pounds of nitrogen	20 26
	$31 04

II.

Dried Fish.

	Per cent.
Moisture at 100° C.	19.34
Organic and volatile matter	62.99
Ash constituents	37.01
Total phosphoric acid	8.90
Nitrogen	5.86
Potassium oxide	.45
Insoluble matter	3.76

Valuation per ton of two thousand pounds: —

9 pounds of potassium oxide	$0 45
178 pounds of phosphoric acid	10 68
117.2 pounds of nitrogen	28 13
	$39 26

Bowker's Dry Ground Fish.

(Collected of Brown & Warner, Northampton, Mass.)

	Per cent.
Moisture	9.00
Organic and volatile matter	71.92
Ash constituents	28.08
Total phosphoric acid	9.60
Nitrogen	5.98

Valuation per ton of two thousand pounds: —

192 pounds of phosphoric acid	$11 52
119.6 pounds of nitrogen	28 70
	$40 22

Bowker's Dry Fish and Potash.

(Collected of Messrs. Brown & Warner, Northampton, Mass

	Per cent.
Moisture	12.60
Total phosphoric acid	10.50
Nitrogen	2.68
Potassium oxide	4.10
Insoluble matter	3.60

Valuation per ton of two thousand pounds: —

210 pounds of phosphoric acid	$12 60
53.6 pounds of nitrogen	12 86
82 pounds of potassium oxide	4 10
	$29 56

Peruvian Guano.

(Sent by H. M. Peirson, Esq., Pittsfield, Mass.)

	Per cent.
Moisture lost at 100° C.	11.22
Organic and volatile matter	48.26
Ash constituents	51.74
Total phosphoric acid	16.70
Soluble phosphoric acid	8.80
Reverted phosphoric acid	2.78
Insoluble phosphoric acid	5.12
Potassium oxide	3.74
Nitrogen	6.80
Insoluble matter	6.62

Valuation per ton of two thousand pounds: —

176 pounds of soluble phosphoric acid	$22 00
55.6 pounds of reverted phosphoric acid	4 95
102.4 pounds of insoluble phosphoric acid	6 14
136 pounds of nitrogen	32 61
74.8 pounds of potassium oxide	3 74
	$69 57

Warranted Peruvian Guano.

(Hobson, Hutardo, & Co.; collected of Messrs. Rice Brothers, Worcester, Mass.)

	Per cent.
Moisture	14.72
Organic and volatile matter	52.16
Ash constituents	47.87
Total phosphoric acid	14.94
Soluble phosphoric acid	6.04
Reverted phosphoric acid	1.98
Insoluble phosphoric acid	6.92
Nitrogen	7.75
Potassium oxide	3.85
Insoluble matter	7.99

Valuation per ton of two thousand pounds: —

120.8 pounds of soluble phosphoric acid	$15 08
39.6 pounds of reverted phosphoric acid	3 56
138.4 pounds of insoluble phosphoric acid	8 30
155 pounds of nitrogen	37 20
77 pounds of potassium oxide	3 85
	$67 99

Guaranteed Peruvian Guano.

(Collected of Messrs. Horton & Phelps, Northampton, Mass.)

	Per cent.
Moisture	7.02
Organic and volatile matter	38.35
Ash constituents	61.65
Total phosphoric acid	23.10
Soluble phosphoric acid	3 30
Reverted phosphoric acid	3.30
Insoluble phosphoric acid	16.50
Nitrogen	6.57
Potassium oxide	2.90
Insoluble matter	7.60

Valuation per ton of two thousand pounds: —

66 pounds of soluble phosphoric acid	$8 25
66 pounds of reverted phosphoric acid	5 94
330 pounds of insoluble phosphoric acid	19 80
131.4 pounds of nitrogen	31 54
58 pounds of potassium oxide	2 90
	$68 43

Guaranteed Peruvian Guano.

(Collected of Messrs. Bagg & Batchelder, Springfield, Mass.)

	Per cent.
Moisture	15.500
Organic and volatile matter	51.850
Ash constituents	48.150

	Per cent.
Total phosphoric acid	13.500
Soluble phosphoric acid	4.030
Reverted phosphoric acid	1.380
Insoluble phosphoric acid	8.090
Nitrogen	7.082
Potassium oxide	2.470
Insoluble matter	10.700

Valuation per ton of two thousand pounds: —

80.6 pounds of soluble phosphoric acid	$10 08
27.6 pounds of reverted phosphoric acid	2 48
161.8 pounds of insoluble phosphoric acid	9 71
141.6 pounds of nitrogen	33 98
49.4 pounds of potassium oxide	2 47
	$58 32

Ammoniated Superphosphates.

Soluble Pacific Guano.

(Collected of Charles E. Wilder, Worcester, Mass.)

	Per cent.
Moisture at 100° C.	14.27
Organic and volatile matter	50.42
Ash constituents	49.58
Total phosphoric acid	11.69
Soluble phosphoric acid	7.42
Reverted phosphoric acid	.69
Insoluble phosphoric acid	3.80
Nitrogen	3.08
Potassium oxide	2.50
Insoluble matter	5.55

Valuation per ton of two thousand pounds: —

148.4 pounds of soluble phosphoric acid	$18 55
13.8 pounds of reverted phosphoric acid	1 24
76 pounds of insoluble phosphoric acid	4 56
61.6 pounds of nitrogen	14 78
50 pounds of potassium oxide	2 50
	$41 63

Standard Superphosphate.

(Collected of Whittemore Brothers, Boston, Mass.)

	Per cent.
Moisture 100° – 105° C.	20.91
Volatile and organic matter	45.80
Ash constituents	54.20

	Per cent.
Total phosphoric acid	12 60
Soluble phosphoric acid	1.92
Reverted phosphoric acid	5.94
Insoluble phosphoric acid	4.74
Nitrogen	2.06
Potassium oxide	3.69
Magnesium oxide	1.00
Insoluble matter	4.54

Valuation per ton of two thousand pounds:—

38.4 pounds of soluble phosphoric acid	$4 80
94.8 pounds of insoluble phosphoric acid	5 69
118.8 pounds of reverted phosphoric acid	10 70
41.2 pounds of nitrogen	9 89
73 8 pounds of potassium oxide	3 69
	$34 77

Food for Plants.

(Collected from Thomas Aubin, Boston, Mass.)

	Per cent.
Moisture at 100° C.	3 38
Organic and volatile matter	42.50
Ash constituents	57.50
Total phosphoric acid	12.60
Soluble phosphoric acid	10.60
Reverted phosphoric acid	–
Insoluble phosphoric acid	2.00
Nitrogen	3.89
Potassium oxide	3.86
Insoluble matter	1.38

Valuation per ton of two thousand pounds:—

212 pounds of soluble phosphoric acid	$26 70
40 pounds of insoluble phosphoric acid	2 40
77.8 pounds of nitrogen	18 67
77 2 pounds of potassium oxide	3 86
	$51 63

Stockbridge's Manures; Corn.

(Bowker & Co.; collected by Puffer & Wilder, Springfield, Mass.)

	Per cent.
Moisture	12.89
Organic and volatile matter	59.60
Ash constituents	40.40
Total phosphoric acid	10 30
Soluble phosphoric acid	6.62
Reverted phosphoric acid	1.91

	Per cent.
Insoluble phosphoric acid	1.77
Nitrogen	4.10
Potassium oxide	5.65

Valuation per ton of two thousand pounds: —

132.4 pounds of soluble phosphoric acid	$16 55
38.2 pounds of reverted phosphoric acid	3 44
35.4 pounds of insoluble phosphoric acid	2 12
82 pounds of nitrogen	19 68
113 pounds of potassium oxide	5 65
	$47 44

Pine-Island Guano.

(Collected of Messrs. Horton & Phelps, Northampton, Mass.)

	Per cent.
Moisture	12.72
Organic and volatile matter	39.59
Ash constituents	60.41
Total phosphoric acid	8.50
Soluble phosphoric acid	5.60
Reverted phosphoric acid	1.49
Insoluble phosphoric acid	1.41
Nitrogen	4.32
Potassium oxide	4.15
Insoluble matter	1.23

Valuation per ton of two thousand pounds: —

112 pounds of soluble phosphoric acid	$14 00
29.8 pounds of reverted phosphoric acid	2 68
28.2 pounds of insoluble phosphoric acid	1 69
86.4 pounds of nitrogen	20 74
83 pounds of potassium oxide	4 15
	$43 26

Bradley's XL Superphosphate of Lime.

(Collected of Messrs. George Robinson & Brooks, Palmer, Mass.)

	Per cent.
Moisture	17.10
Organic and volatile matter	57.68
Ash constituents	42.32
Total phosphoric acid	13.32
Soluble phosphoric acid	9.30
Insoluble phosphoric acid	2.00
Nitrogen	2.93
Potassium oxide	1.73
Insoluble matter	3 20

Valuation per ton of two thousand pounds: —

186 pounds of soluble phosphoric acid	$23 25
40 pounds of insoluble phosphoric acid . . .	2 40
58.6 pounds of nitrogen	14 06
34.6 pounds of potassium oxide	1 73
	$41 44

Bradley's Sea-Fowl.

(Collected of Messrs. Sheldon & Newcomb, Greenfield, Mass.)

	Per cent.
Moisture	11.26
Organic and volatile matter	55.95
Ash constituents	44.05
Total phosphoric acid	12.13
Soluble phosphoric acid	8.15
Reverted phosphoric acid	1.22
Insoluble phosphoric acid	2.76
Nitrogen	3.66
Potassium oxide	2 51
Insoluble matter	4.95

Valuation per ton of two thousand pounds: —

163 pounds of soluble phosphoric acid	$20 37
24.4 pounds of reverted phosphoric acid . . .	2 20
55.2 pounds of insoluble phosphoric acid . . .	3 31
73.2 pounds of nitrogen	17 57
50.2 pounds of potassium oxide	2 51
	$45 96

Ammoniated Superphosphate of Lime.

(Preston Fertilizer Co.; collected of Messrs. Spaulding & Co., Northampton, Mass.)

	Per cent.
Moisture	13.30
Organic and volatile matter	41.60
Ash constituents	58.40
Total phosphoric acid	13.02
Soluble phosphoric acid	9.54
Reverted phosphoric acid	1.44
Insoluble phosphoric acid	2.04
Nitrogen	2.38
Insoluble matter	5.40

Valuation per ton of two thousand pounds: —

190.8 pounds of soluble phosphoric acid . . .	$23 85
28.8 pounds of reverted phosphoric acid . . .	2 59
40.8 pounds of insoluble phosphoric acid . . .	2 45
47 6 pounds of nitrogen	11 42
	$40 31

Bone Fertilizer.

(Sent by A. L. Amos, Esq., Peabody, Mass.)

	Per cent.
Moisture at 220° F.	7.31
Organic and volatile matter	60.90
Ash constituents	39.10
Total phosphoric acid	12.99
Soluble phosphoric acid	8.13
Reverted phosphoric acid	1.75
Insoluble phosphoric acid	3.11
Nitrogen	4.64
Insoluble matter	.48

Valuation per ton of two thousand pounds: —

162.6 pounds of soluble phosphoric acid	$20 33
35 pounds of reverted phosphoric acid	3 15
62 2 pounds of insoluble phosphoric acid	3 73
92.8 pounds of nitrogen	22 27
	$49 48

Mitchell's Standard Phosphate.

(Collected of Messrs. Rice Brothers, Worcester, Mass.)

	Per cent.
Moisture	14.99
Organic and volatile matter	53.83
Ash constituents	46.17
Total phosphoric acid	12.42
Soluble phosphoric acid	9.85
Reverted phosphoric acid	–
Insoluble phosphoric acid	2.57
Nitrogen	2.64
Potassium oxide	2.16
Insoluble matter	2.68

Valuation per ton of two thousand pounds: —

197 pounds of soluble phosphoric acid	$24 66
51.4 pounds of insoluble phosphoric acid	3 08
52.8 pounds of nitrogen	12 67
43.2 pounds of potassium oxide	2 16
	$42 57

Bosworth Brothers' Ammoniated Bone Superphosphate.

(Collected of Messrs. Holden & Wilson, Worcester, Mass.)

	Per cent.
Moisture	8.00
Organic and volatile matter	41.71
Ash constituents	58.29

	Per cent.
Total phosphoric acid	14.33
Soluble phosphoric acid	4.44
Reverted phosphoric acid	7.15
Insoluble phosphoric acid	2.74
Nitrogen	2.64
Insoluble matter	1.13

Valuation per ton of two thousand pounds:—

88.8 pounds of soluble phosphoric acid	$11 10
143 pounds of reverted phosphoric acid	12 87
54.8 pounds of insoluble phosphoric acid	3 29
52.8 pounds of nitrogen	12 57
	$39 83

Standard Superphosphate.

(Collected of William E. Earle, Worcester, Mass.)

	Per cent.
Moisture at 100° C.	23.61
Organic and volatile matter	51.13
Ash constituents	42.87
Total phosphoric acid	10.99
Soluble phosphoric acid	8 32
Reverted phosphoric acid	.24
Insoluble phosphoric acid	2 43
Nitrogen	2.36
Potassium oxide	1.87
Magnesia	1.16
Insoluble matter	3.77

Valuation per ton of two thousand pounds:—

166.4 pounds of soluble phosphoric acid	$20 80
4.8 pounds of reverted phosphoric acid	43
48 6 pounds of insoluble phosphoric acid	2 92
47.2 pounds of nitrogen	11 33
37.4 pounds of potassium oxide	1 87
	$37 35

Bowker's Hill and Drill Fertilizer.

(Collected of Messrs. Puffer & Wilder, Springfield, Mass.)

	Per cent.
Moisture	12.10
Organic and volatile matter	51.16
Ash constituents	48.84
Total phosphoric acid	14.17
Soluble phosphoric acid	7.52
Reverted phosphoric acid	1.34
Insoluble phosphoric acid	5.31

	Per cent.
Nitrogen	2.70
Potassium oxide	None.
Insoluble matter	4.40

Valuation per ton of two thousand pounds:—

150.4 pounds of phosphoric acid	$18 80
26.8 pounds of reverted phosphoric acid	2 41
106.2 pounds of insoluble phosphoric acid	6 37
54 pounds of nitrogen	12 96
	$40 54

Bay-State Bone Superphosphate.

(Collected of Messrs. G. S. Clark & Son, Worcester, Mass.)

	Per cent.
Moisture	24.86
Organic and volatile matter	64.44
Ash constituents	35.56
Total phosphoric acid	10.25
Soluble phosphoric acid	8.28
Reverted phosphoric acid	1.03
Insoluble phosphoric acid	.94
Nitrogen	2.64
Potassium oxide	1.16
Insoluble matter	1.26

Valuation per ton of two thousand pounds:—

165.6 pounds of soluble phosphoric acid	$20 70
20.6 pounds of reverted phosphoric acid	1 85
18.8 pounds of insoluble phosphoric acid	1 13
52.8 pounds of nitrogen	12 67
23.2 pounds of potassium oxide	1 16
	$37 51

Matfield Lawn-Grass Fertilizer.

(Collected of W. H. Earle, Worcester, Mass.)

	Per cent.
Moisture	21.48
Organic and volatile matter	45.64
Ash constituents	54.36
Total phosphoric acid	3.09
Soluble phosphoric acid	.65
Reverted phosphoric acid	1.80
Insoluble phosphoric acid	.64
Nitrogen	3.37
Potassium oxide	8.25
Magnesium oxide	1.40
Insoluble matter	5.60

Valuation per ton of two thousand pounds:—

13 pounds of soluble phosphoric acid	$1 62
36 pounds of reverted phosphoric acid	3 24
12.8 pounds of insoluble phosphoric acid	77
67.4 pounds of nitrogen	16 18
165 pounds of potassium oxide	8 25
	$30 06

Russel Coe's Ammoniated Superphosphate.

(Collected of Rice Brothers, Worcester, Mass.)

	Per cent.
Moisture	24.90
Organic and volatile matter	53.48
Ash constituents	46.52
Total phosphoric acid	15.04
Soluble phosphoric acid	.49
Reverted phosphoric acid	11.45
Insoluble phosphoric acid	3.10
Nitrogen	2.42
Insoluble matter	6.33

Valuation per ton of two thousand pounds:—

9.8 pounds of soluble phosphoric acid	$1 22
229 pounds of reverted phosphoric acid	20 61
62 pounds of insoluble phosphoric acid	3 72
48.4 pounds of nitrogen	11 62
	$37 17

Bradley's XL Ammoniated Superphosphate.

(From David Mayhew, Esq., North Tisbury, Mass.)

	Per cent.
Moisture	19.20
Organic and volatile matter	45.48
Ash constituents	54.52
Total phosphoric acid	12.50
Soluble phosphoric acid	5.00
Reverted phosphoric acid	4.10
Insoluble phosphoric acid	3.40
Nitrogen	2.36
Potassium oxide	2.07
Insoluble matter	3.37

Valuation per ton of two thousand pounds:—

100 pounds of soluble phosphoric acid	$12 50
82 pounds of reverted phosphoric acid	7 38
68 pounds of insoluble phosphoric acid	4 08
47.2 pounds of nitrogen	11 33
41.4 pounds of potassium oxide	2 07
	$37 36

F. Coe's Ammoniated Bone-Superphosphate.

(Collected of Messrs. Sheldon & Newcomb, Greenfield, Mass.)

	Per cent.
Moisture	15.39
Organic and volatile matter	57.32
Ash constituents	42.68
Total phosphoric acid	11.87
Soluble phosphoric acid	9.09
Reverted phosphoric acid	.13
Insoluble phosphoric acid	2.65
Nitrogen	3.35
Insoluble matter	3.42

Valuation per ton of two thousand pounds: —

181.8	pounds of soluble phosphoric acid	$22 72
2.6	pounds of reverted phosphoric acid	2 34
53	pounds of insoluble phosphoric acid	3 18
67	pounds of nitrogen	16 08
		$44 32

Bowker's Lawn-Dressing.

(Collected of Messrs. Wilson & Holden, Worcester, Mass.)

	Per cent.
Moisture	9.67
Organic and volatile matter	49.77
Ash constituents	50.23
Total phosphoric acid	7.73
Soluble phosphoric acid	5.31
Reverted phosphoric acid	.80
Insoluble phosphoric acid	1.62
Nitrogen	4.93
Potassium oxide	3.75
Insoluble matter	3.03

Valuation per ton of two thousand pounds: —

106.2	pounds of soluble phosphoric acid	$13 27
16	pounds of reverted phosphoric acid	1 44
32.4	pounds of insoluble phosphoric acid	1 94
98.6	pounds of nitrogen	23 66
75	pounds of potassium oxide	3 75
		$44 06

Bowker's Ammoniated Food of Flowers.

(Collected of Massachusetts Agricultural College.)

	Per cent.
Moisture	10.42
Organic and volatile matter	52.06
Ash constituents	47.94
Total phosphoric acid	11.90
Soluble phosphoric acid	8.06
Reverted phosphoric acid	2.24
Insoluble phosphoric acid	1.60
Nitrogen	4.02
Potassium oxide	2.80
Insoluble matter	.48

Valuation per ton of two thousand pounds:—

161.2 pounds of soluble phosphoric acid	$20 15
44.8 pounds of reverted phosphoric acid	4 03
32 pounds of insoluble phosphoric acid	1 92
80.4 pounds of nitrogen	19 30
56 pounds of potassium oxide	2 80
	$48 20

Bradley's XL Superphosphate.

(Collected of Messrs. Sheldon & Newcomb, Greenfield, Mass.)

	Per cent.
Moisture	14.73
Organic and volatile matter	59.11
Ash constituents	40.89
Total phosphoric acid	10.50
Soluble phosphoric acid	8.66
Reverted phosphoric acid	1.11
Insoluble phosphoric acid	.73
Nitrogen	3.56
Potassium oxide	1.30
Insoluble matter	3.57

Valuation per ton of two thousand pounds:—

173.2 pounds of soluble phosphoric acid	$21 65
22.2 pounds of reverted phosphoric acid	2 00
14.6 pounds of insoluble phosphoric acid	88
71.2 pounds of nitrogen	17 09
26 pounds of potassium oxide	1 30
	$42 92

Bradley's Original Coe Superphosphate.

(Collected of Messrs. Horton & Phelps, Northampton, Mass.)

	Per cent.
Moisture	15.30
Organic and volatile matter	56.38

	Per cent.
Ash constituents	43.62
Total phosphoric acid	14.20
Soluble phosphoric acid	9.30
Reverted phosphoric acid	1.86
Insoluble phosphoric acid	3.04
Nitrogen	2.91
Potassium oxide	.83
Insoluble matter	3.31

Valuation per ton of two thousand pounds: —

186 pounds of soluble phosphoric acid	$23 25
27.2 pounds of reverted phosphoric acid	2 45
60.8 pounds of insoluble phosphoric acid	3 65
58.2 pounds of nitrogen	13 97
16.6 pounds of potassium	83
	$44 15

Guy's German Plant-Food for Flowers.

(Collected of Guy Brothers, Boston, Mass.)

	Per cent.
Moisture at 100° C.	4.37
Organic and volatile matter	60.36
Ash constituents	39.64
Total phosphoric acid	8.91
Soluble phosphoric acid	7.81
Reverted phosphoric acid	.71
Insoluble phosphoric acid	.39
Nitrogen	8 43
Potassium oxide	.27
Insoluble matter	4.13

Valuation per ton of two thousand pounds: —

156.2 pounds of soluble phosphoric acid	$19 53
14.2 pounds of reverted phosphoric acid	1 28
7.8 pounds of insoluble phosphoric acid	47
168.6 pounds of nitrogen	40 46
5.4 pounds of potassium oxide	27
	$62 01

Peat.

I.

(Collected of Mr. Tillson, Massachusetts Agricultural College.)

	Per cent.
Moisture at 100° C.	85.34
Vegetable matter	13.14
Ash constituents	1.52
Nitrogen	.41

In air-dry state, 20 per cent moisture, 2.314 per cent nitrogen.

II.

Hampden County.

	Per cent.
Moisture at 100°–105° C.	75.03
Organic and volatile matter	97.61
Ash	2.39
Nitrogen (in organic matter)	.67

III.

Hampden County.

	Per cent.
Moisture lost at 105° C.	68.79
Organic and volatile matter	84.17
Ash	15.83
Nitrogen (in organic matter)	.61

APPENDIX.

COMPOSITION OF SOME COMPOUNDS IN FERTILIZERS.

One hundred parts of: —

Nitric acid contain 26 parts of nitrogen.

Ammonia contain 82.35 parts of nitrogen.

Pure nitrate of potassa (saltpetre) contain 53.4 parts of nitric acid and 46.6 parts of potassium oxide.

Pure nitrate of soda (Chili saltpetre) contain 63.25 parts of nitric acid.

Chloride of potassium contain 52.4 parts of potassium, 63.1 parts of potassium oxide, and 47.6 parts of chlorine.

Pure sulphate of potassa contain 54.9 parts of potassium oxide and 46 parts of sulphuric acid.

Bone phosphate (tricalcic phosphate) contain 46 parts of phosphoric acid and 54 parts of calcium oxide (lime).

Calcined gypsum contain 41 parts of calcium oxide (lime) and 59 parts of sulphuric acid.

Uncalcined pure gypsum contain 32.5 parts of calcium oxide (lime), 46.5 parts of sulphuric acid, and 21 parts of water.

Carbonate of lime contain 56 parts of calcium oxide (lime) and 44 parts of carbonic acid.

Sulphate of magnesia (free of water) contain 33.3 per cent of magnesium oxide (magnesia) and 66.6 per cent of sulphuric acid.

C. A. GOESSMANN.

Professor Goessmann asked instruction from the Board in regard to presenting to the public the market-value of the constituents of commercial fertilizers. The Board unani-

mously voted that Professor Goessmann should continue to give valuations as heretofore.

Mr. Grinnell then read a paper on

THE AGRICULTURE OF MASSACHUSETTS FOR FORTY YEARS.

The question is often asked, "What has caused the decline of agriculture in this Commonwealth?" And answers are given in a spirit of unintelligence, equal, in both the asker and the questioned, as to the real facts, which, when examined, show the assumed premises of a decline to be entirely incorrect in their conception.

It has for some years become quite common to decry the agriculture of our own State, to speak of it in a deprecatory manner, as if, when compared with other professions or occupations, it were a thing of secondary or even of tertiary importance, highly respectable to be sure, but not an elevated nor a paying profession, nor one which a man would follow if he had any other means of obtaining a living.

Farming at the East is by many regarded as too laborious and unremunerative. Young men, and old ones too, quit their comfortable homes and a reasonably independent living for the precarious chances of trade in towns and cities, or the uncertain risks of a shifting and dependent employment in and about mills, railways, and factories, or the scarcely less perilous chances of tilling the fertile but malarious lands of the West and South, or rending the bowels of the earth for precious metals; overlooking, in their desire for sudden and easily acquired riches, the priceless compensation of culture, society, schools, and the church, which they in their westward movement leave behind them.

For much of the desertion of the farm, and this seeking other localities and easier occupation by the children, the fathers themselves are largely responsible.

As a class, farmers certainly incline to be complaining, and discontented with their lot, looking downward and backward rather than upward and onward. They have not formerly taken the pains they should to make their homes bright and cheerful, attractive to the young people; nor have they encouraged their efforts, or mitigated the austerities of their

labors, by sufficient consideration in occasional holidays off the farm with means of amusement, by consulting them on the management of the farm, or by making them, to some degree, partners or proprietors of some individual property (as a colt, a calf, or a lamb), the ownership of which, with the right to trade, gives a feeling of independence, and is one of the first steps tending to educate the young farmer, and to keep him contented upon the paternal acres.

A child growing up, if regarded with some consideration (something beyond mere paternal oversight), shown a little equality and companionship, will be much more likely to be reconciled to the life on the farm than if treated as a mere hireling, or, even worse than that, as a worker without wages and without sympathy, unregarded, and with every thing to make life enjoyable, except mere food, denied or grudgingly allowed.

It has been a conundrum of many years' standing, how to keep the boys upon the farms, and to make them appreciate the advantages they enjoy, and the motives which really should actuate them, as the children of Massachusetts, to stay at home.

Her rewards to industry, enterprise, and good conduct, directed by intelligence and under the guidance of temperance and of prudence in the cultivation of her soil, are sufficient to satisfy every reasonable desire, any proper moderate ambition.

Her social and religious institutions and privileges are preeminent, and such as no new and uncultivated territory can expect to reach, under the most favorable circumstances, for many years.

Inquiring for the reasons why farming is declared by many to be less profitable than formerly, and therefore to have declined, after the natural tendency of us all to magnify the past by depreciating the present, a prominent one is to be found in the fact that farmers themselves are quite too much inclined to belittle their occupation, its resources and results, underrating their advantages and blessings, and magnifying their difficulties and troubles, constantly complaining that they have to work too hard, and that they "can't make any thing at farming;" and yet they have good homes, good living, comfortable clothing, educated and well-

cared-for families. They have a surplus for sale, and trade and speculate when an opportunity occurs.

It is true, they do not become suddenly wealthy; they do not on some fine morning find themselves thousands of dollars richer than when they went to bed the night before by a rise in railway or mining stocks; they do not see the hundreds daily coming in, earned by a long, anxious, persistent drudgery of years, at the sacrifice of health and peace of mind, behind the counter or on the wharf. Nor, on the other hand, do they make such disastrous failures, and find themselves overwhelmed in such utter ruin, as too often occurs to those who build on the uncertain foundations of trade.

It is a widely proclaimed fact that only about one farmer who prudently and faithfully tills the soil becomes a bankrupt as against nine of those who commit themselves to the vicissitudes of trade and manufactures.

When a hard-working farmer of correct habits, good judgment, and reputable character, fails, as we say, or becomes bankrupt, it may be very generally traced to one of three causes. Of course, a man may be pecuniarily ruined by such things as destruction by flood or fire, loss of animals or crops, or by wasting sickness; but these are the exceptional cases, and usually it will be found either that he commenced his farming in debt by an improvident purchase, or, oftener, with an ambition beyond his means, by taking his father's farm (the old homestead where he was born and reared), probably a good deal run down, perhaps encumbered by mortgage, or with brothers and sisters to pay off or support, and perhaps with other encumbrances, making a load of interest and expenses under which he staggers for years, until at last, wearied and bowed down, he trips against some slight misfortune, and falls with a crash.

Another, prosperous and forehanded, successful to such an extent as to have made his credit high and bankable, free from debt, and trusting in others, has, in the kindness or the weakness of his nature, been induced to incur obligations for them which he is unexpectedly and often cruelly called upon to meet. Dismayed, crushed, almost stupefied, he is at last to see his farm, stock, implements, home, — every thing, — in the icy hand of the sheriff, all swept away, except the paltry allowance made by the State to an insolvent debtor.

Another, with an ambitious desire to further increase his gains, and over-confident in his own judgment and forecast, has ventured outside his legitimate calling to risk his money and his credit in some flattering but delusive speculation, only to find that both have gone "like the bubble on the fountain — gone and forever." But cases like these which have occurred in every community, productive of much distress, and exciting deep sympathy, are not to be cited to prove farming unprofitable. Nor, too, is it to make against our profession, if a farmer who is intemperate, lazy, thriftless, or, as we Yankees say, "shiftless," comes to the hammer, and goes to the bad. Any man in any business, with such disqualifications, would come to nought.

The rewards of agricultural labor in Massachusetts are ample, in that an industrious, prudent man, with a fair start, out of debt, may not only obtain, by skilful and careful farming, a comfortable subsistence, but his gains will prove so much more than his real and reasonable wants, that, in ordinary circumstances, he may early enter into the holy estate of matrimony, rear and educate a family of children, have the means of healthful and abundant comfort, exercise a liberal hospitality, and lay up a competent provision against the casualties of human affairs and the decline of life. Cases like these are most common among us, and are the rule, while the others are the exceptions.

Agriculture, in the view of every political economist, is the foundation of national wealth: it creates matter, and gathers its productions, without injury or diminution, from the exhaustless resources of the air and earth.

Every agricultural production, therefore, is a direct creation of so much additional matter. This, however, is not all: it is not, as in manufactures, the mere using-up or transforming of raw material; but, under good cultivation, the soil itself is put in a condition to become more productive, and the land itself is raised in value in proportion to the increased income which can be obtained from it. Labor thus applied may be regarded as a sure and permanent investment of productive capital.

It is unfortunate that this investment does not always return the results hoped and expected, and especially that so many of our people within the past forty years, dissatisfied

with these returns, which they consider a want of success in farming, should have sought new homes elsewhere.

And yet this is not without a certain compensation. In the population of all civilized countries two forces are constantly at work, which, without much wresting of language, may be called the centripetal and centrifugal motions. One is a tendency, in redundant outlying inhabitants, to centralization (or drawing into cities and manufacturing towns a portion of this superfluity for work and wages) or to the cultivation of lands in their immediate vicinity, to supply the food-products necessary to support this large non-producing part of our population. The other, equally active, and perhaps more potent in results, is the disposition to migrate to broader fields and more untrammelled action. As a farmer's sons attain to manhood, they feel that they must do something for themselves. The paternal farm will not usually bear dividing. Manly pride and inborn independence forbid their continuance in service merely as "hired men;" and thus most of them must go elsewhere. Some are content to try their fortunes in towns and cities where their success is attested by the fact that more than four-fifths of the most prosperous business men were raised on the farm: others, with a larger ambition, strike out to make themselves homes in new lands and among a sparse population.

Thus from this necessity — the impossibility of all remaining at the old home — come the most successful men of the towns; and from the same source — New-England farms — new States are settled, populated, and governed.

An examination of the Federal census of 1830, and a comparison with it of the returns just collected by the census of 1880, show an increase in the population of the whole State, during the past fifty years, of 1,172,604; and it also shows a steady, almost unvarying increase, since 1776, in every county in the State, with the exceptions of Barnstable, Dukes, and Nantucket, — never agricultural counties, and which have lost during the past fifteen years, through the continued depression and destruction of their fisheries, only about four thousand. Although the counties have made steady gains, it will not be supposed that all the towns in a county have: some of them, on the contrary, have lost more than half the

population they owned fifty years ago, while others have grown from hamlets to popular cities in the same county.

Except in the three counties above mentioned, the decrease has, in almost every case, been from the hill towns, and the accretions to those through which lines of railroads have been conveniently located, or manufactures established.

Another assigned reason for the supposed decline of our agriculture, and perhaps the most prominent, is the lessened numbers of some classes of our animals, and greatly reduced amounts of certain crops; while the greatly improved character of our animals and quality of our crops, with consequently largely enhanced values and prices, are quite unknown or overlooked.

In speaking of a decline in our agriculture, we can only prove or disprove it by a careful comparison of the productions of the present with those of the past; and I have, as the date of the past, taken the indefinite time covered by the Federal census of 1840 and 1850 (the earliest returns of agriculture) and our State valuation of 1845, and, as the recent date, I have taken our admirable State census of 1875 (the latest full information we have), with some returns from the Federal census of 1880, for which I am indebted to the courtesy of the able superintendent.

And it will be observed, too, that, in making these comparisons with any accuracy or effect, it is not merely in looking at *gross* amounts, but at individual values, acreages, and quality, that we must determine this vexed question of decline.

In making this examination, the all-important fact to be noted is, that, while there has been a great decrease in the number of our animals and in the aggregate of some crops, yet, in every single instance, it will be seen that the increase in the value of the animals individually, and of the different crops by measure, and in the amounts grown to the acre of each, and the vastly improved quality as shown by the prices, — all indicate a wonderful improvement in our breeding and our cultivation, ranging from twenty to a hundred per cent.

And be it remembered, too, that if the gross amounts in certain branches of our stock, and in certain crops of our production, have been reduced in later years by importation

from the West of articles the increased demand for which we could not supply, or which could be brought to our doors so cheaply that we could better afford to make other crops, or raise other animals at such a profit as to warrant us in so doing, and thus paying for these imported articles, — this is not by any means to be taken as an evidence of poor farming, or a decline in our agriculture, which has not declined in theory or in practice. Within the past half-century, greater advance has been made in scientific and practical agriculture than in any two hundred preceding years; and this has been the case in every department of science and of art.

Society has changed, and greater requirements are made in every ramification of our lives; and the ingenuity of man has been taxed, and successfully, to meet them. Nowhere does this manifest itself more forcibly than in our agricultural operations.

While these various reasons have operated to give so general an impression that we are retrograding in our farming, it is well to remember that appearances are proverbially deceptive, and that often "things are not what they seem." And we shall find this eminently true of the subject in hand, and that the only way to get at the real condition of our agriculture is to take the figures, as given in successive decades by United-States marshals and by our town assessors, taken every five years alternately from 1840 to 1880; and no exception can fairly be taken to these sworn returns, which are the basis of our government expenditures, and must be admitted to be authority.

The valuations given below are taken from the assessors' returns for 1845 and 1875, and are nearly enough correct for our purposes; the values of our farm-products being about as much higher now than in 1875 as the difference between gold and currency then. We are obliged to take these figures, because the Federal census gives only amounts, and not values.

Forty years ago we had of neat-cattle in this State 282,574 head, worth $5,439,549, while in 1880 our neat-cattle numbered only 261,121, — over 21,000 less than those of 1840; but their value was $12,076,846, or $6,637,297 more than those of 1840, which then averaged only $19.25 per head, while the cattle of 1875 averaged $46.25 each.

This enormous increase in the value of our cattle results from the introduction of the best English breeds by the old "Massachusetts Society for the Promotion of Agriculture" (ever forward in advancing the interests of the farmers of this State) and by some public-spirited individuals in the eastern part of the State, and by the readiness and good judgment of our farmers in using these animals for the improvement of their herds of native cows; and also from the wise action of the State Board of Agriculture in excluding grade bulls from receiving premiums at the county shows, which has undoubtedly had much influence in advancing the character of our cattle.

Consider what a wonderful progress we have made in this direction. Less than fifty years ago there was not a Jersey in the State. There were then no pure-bred Devons nor Herefords. The first Ayrshires had just been imported by Mr. J. P. Cushing and the Massachusetts Society, and were still on trial; and even the Durham shorthorns, as they were then called, had not been so thoroughly tested as to satisfy all that they would endure the rigor of our climate, and prove desirable for the dairy.

The first bull of this noble breed, named "Cicero," with a full pedigree, was brought in by Mr. Coolidge of Boston, in 1818; then "Denton," the same year, by Mr. Williams, who sent him to Worcester, where he did great service; and, in 1820, "Fortunatus," "Cœlebs," and other grand bulls and cows by wealthy and public-spirited gentlemen of Boston; in 1823, "Admiral," sent by Sir Isaac Coffin, and some cows. From these, all well-bred bulls from the best herds of England, started our numerous shorthorns, which have given figure and style to the cattle of the State to such an extent, that such a beast as a "native" can scarcely be found.

These, for many years, furnished us with splendid grades for the stall; but stall-feeding has mostly gone by for us. Our beef now very generally comes from the Far West, — either on the hoof, or as dressed carcasses in refrigerator-cars, — not only for consumption here, but for export across the seas.

We do not raise as many young cattle as formerly; for, while we have 150,505 milch cows, as against 130,100 in 1850, we have only 38,000 calves growing up; but we send 3,600,000 pounds of veal to the butcher annually.

Our working-oxen now are only 14,571, as against 46,611 in 1850. Lamentable as it is, the ox, as a steady force on the farm, is being superseded by the horses, which went from 42,216 in 1850, to 59,629 in 1880, valued in 1845 at $53 each, and amounting to $2,237,448, while the horses of 1880, at a valuation of $110 each, amounted to $6,501,561; showing a gain in horse-flesh alone, on farms, of over $4,264,000, which certainly indicates a healthy decline in that direction.

At that time we were just breeding to horses of Morgan stock, having in the western and northern parts of the State the Cock of the Rock, Bulmeh, Sherman, and Woodbury Morgans.

At the East they had, among other thoroughbreds, some of the Messenger blood, and a grand horse called "Bellfounder," imported by Col. Jaques of the "Ten Hills Farm" at Charlestown, which left a fine strain of blood.

In later years we are breeding, more than then for speed, fast driving-horses, and seek to accomplish this, and to secure more endurance (bottom), by crossing with horses thoroughbred, or as nearly so as fast trotters can be found.

Our draught-horses, too, are being improved by an infusion of Perchoron blood, imported by the Massachusetts Society, which has proved very successful, and also by Clydesdales and Normans, which now come to us from Canada and the West.

SHEEP.

In the matter of sheep-growing and wool-producing, we have shown such a great falling-off, and such persistent negligence in this most profitable branch of our farming, as to have branded us as failing in our agriculture; and this, more than any other single thing, has brought reproach upon our skill, judgment, and foresight.

In 1838 we had 384,614 sheep, which sheared 1,056,327 pounds of wool; we had, in 1875, but 58,773 sheep, shearing 206,935 pounds of wool: showing, in less than forty years, a decrease of 325,841 sheep and 850,000 pounds of wool, or at the rate of over 8,000 sheep annually.

This diminution was mostly among the Saxonies and Merinos, which, at that early date, constituted two-thirds of all the sheep kept. It was thought impossible to compete with the West and South in raising those sheep and growing fine

wool at a sufficient profit; and instead of turning their attention to the more profitable branch of sheep-husbandry, early lambs, and mutton, farmers, in disgust, sold their flocks of little Merinos, or allowed them to dwindle down, and never replaced them. Bad as this showing is, there is some consolation to be found in scanning the figures, and in the hope of a sensible return to the keeping of sheep, as evidenced by the fact, that, from 1875 to 1880 (five years), our sheep increased 6,350, or over 1,200 a year.

There is a very decided impression among the farmers in every part of the State, generally, that this most profitable and pleasant branch of our farm-industry would be doubled but for the destruction of their sheep by dogs, — a terrible evil to those who are attempting to keep sheep, and deterring hundreds of others who would like to raise them if they could be protected. It must be overcome in some way, — either by additional legislation, or by more stringent enforcement of the laws we have, or both.

Of the sheep of 1840, over two-thirds were Saxonies or Merinos, which were valued at $1.57 each, and which sheared an average of only two pounds and fourteen ounces to the fleece of wool, worth 38 cents per pound; their lambs, when raised, being worth from $1 to $1.50 each, and rearing only about 75 lambs out of 100 ewes. Now, it is not strange that the farmers of those days were sick of such sheep, and found that growing fine wool didn't agree with them; but it is strange that more of them hadn't enterprise and forecast enough to shape their course somewhat after the fashion of the present day.

In 1875 our sheep averaged $4.50 each, sheared four pounds of wool worth 42 cents per pound, and raised nearly 30,000 lambs (at the lowest rate of 110 lambs to the 100 ewes), averaging in most counties $4 each, and thousands selling from $7 to $10 each, — amounting, in all, to over $115,000.

Herein consists our improvement: our sheep have nearly trebled in value; they have nearly doubled in the weight of fleece (which is worth ten per cent more than then), while the lambs we raise are a third more in number, and worth, each, three or four times as much as then; and this comes from the new departure, — in making mutton and

lambs the first consideration, and the wool secondary (which is medium, combing, and coarse), that we can produce from larger and more profitable sheep, and which, sheep for sheep, is worth more than the fine-woolled fleece.

When the farmers in Franklin County can keep their ewes for $1 in summer, and $2.50 in winter, with $2 for the lamb's feed (making in all $5.50), and receive $1.60 for the fleece and $7.70 for the lamb (counting twelve per cent of twins), leaving, beside the old sheep, nearly $4 net profit, with a cord of the best manure for every ten sheep (to pay for the labor of attending them), — who, comparing this with sheep-keeping forty years ago, will say there has been any decline in this branch of our agriculture?

SWINE.

Another item of farm-stock, which has apparently decreased in numbers, is swine. In 1845 we had 104,740 swine, appraised at $917,435 (at $8.75 each): in 1875 we had 41,255 hogs and 41,009 pigs, valued at $963,321; showing, that, by our improved breeding and care, 21,485 less swine than were kept in 1845 were in 1875 worth $45,886 more.

In those days but little attention had been paid to the breeding of hogs for fine points in this part of the country, or, indeed, anywhere. The farmers had the Grassfed, or Irish Graziers, from New York, the Mackay and the Byfield, both which originated in the eastern part of our own State, and which soon ran out because there was no fixity of type. Then the Berkshires were introduced about 1832; but they did not, at that time, meet the expectations of breeders, and fell into disfavor, though within the last dozen years they have greatly improved.

About 1844 the Suffolks were introduced by the Messrs. Stickney of Boston, and have been of great service in fining down our larger breeds of pigs. Since then we have had the Chester Whites, the Poland China (or Magio), and the Yorkshire, the last imported by the Massachusetts Society.

Forty years ago farmers thought they did well in bringing their hogs to dress 350 or 400 pounds at fifteen or sixteen months old, while we make them, at that age, 500 to 550, or, better still, at eight or nine months old we make them dress 250 to 300 pounds.

POULTRY.

Perhaps the most remarkable showing is in the poultry and eggs, which in 1840 were estimated at $178,157, and in 1875 at $1,789,000, the eggs alone being worth nearly $1,000,000. 'Tis but a few years since the only fowls we had were the common dunghill fowls, so-called: they laid their eggs where they chose; and those which were not discovered by the farmers' children or the hired men were hatched where they were laid, and such chicks as escaped the perils of skunks, hawks, rats, and other vermin, were sacrificed at Thanksgiving, illy-grown and carelessly fattened. Now our fowls bred for a purpose are very commonly confined in convenient houses: they lay their eggs in appointed places, their chickens are cared for, their manure almost as much valued as grain, while the dressed poultry and eggs, though in amounts individually small, when collected and summed up, show an aggregate that is wonderful.

HAY.

Of hay, we cut, in 1840, 569,395 tons, valued at $4,908,184, appraised at $8.50 per ton: in 1875 we mowed 671,130 tons (over 6,000 more than we ever cut in any year), worth $10,660,268 at $15 per ton, — a gain of over $6,752,000.

The improvement in our hay-crop is one of the most healthy evidences of our advancement in agriculture. It is certain that good, sweet, well-cured hay, of one kind or another, is the strength, the main stay, of our New-England farming. Corn, wheat, rye, oats, or potatoes may fail by blight, mildew, rust, insects, or any other of the plagues which the farm has to encounter; but, with good hay, every animal on the farm cannot only live, but thrive, if its capability be not over-taxed: and one of the greatest gains we have made in our farming is in improving our mowing-lands, and in getting our hay early and quickly, as taught us by the chemistry of the farm, and accomplished by means of, and through the perfection of, our agricultural machines and implements, which are a blessing not vouchsafed to the farmers of fifty years ago.

CORN.

We raised of corn, in 1840, 1,809,192 bushels, worth 68 cents per bushel; and year by year the quantity was increased, till it reached its highest point, in 1855, of over 2,500,000. From this it gradually decreased till 1875, after which it advanced at such a rate, that in 1880 it was only 11,597 bushels less than in 1840; but at the going price of Northern corn (90 cents per bushel) it amounts to $1,617,-735, or $387,485 more than the crop of forty years ago, and the most encouraging feature is an increase of nearly 800,000 bushels during the past five years.

The lessening of the amount of corn-growing was partly owing to the eagerness with which people in every county of the State, except Nantucket, pursued the cultivation of tobacco, which for some years brought large sums (running from $57,000 to $1,500,000), but consumed the best corn-land the most and best of the manure, and a very large proportion of labor and attention.

For feeding to cattle, farmers have thought they could import corn from the West at a less price than they could afford to raise it; and this may be so, where every thing must be done by hand-labor. If fields are large enough and smooth enough to use horse-power in planting and cultivating, corn can be grown here for a less price than we pay for Western, which is not as good.

Mr. Bowditch of Framingham raised on seventeen acres and a quarter 100 bushels shelled corn to the acre at a cost, carefully kept, of 30½ cents per bushel, and with no hand-labor till harvesting.

Some half-dozen competitors in Franklin County for the special premium reported to have raised from 75 to 100 bushels of corn to the acre at a cost of only 22 to 35 cents per bushel.

OATS.

The decrease for some years in the crop of oats is partly accounted for by importation; but probably not as many are used or raised as formerly.

In 1845 we grew 1,238,159 bushels, which, at 33 cents per bushel, amounted to $405,657: in 1880 we harvested 645,159 bushels, which, at 64 cents per bushel, amounted to $412,901, or $7,244 more than the crop forty years ago.

Many farmers think they can more easily, if not profitably, raise fruits, large and small, market-vegetables, potatoes, or tobacco, and buy grains to feed their cattle, and special fertilizers to supply the lack of farmyard-manure caused by neglecting corn and grain crops. Doubtless they are somewhat justified in this, and specially in the crops of tobacco and potatoes.

POTATOES.

Potatoes, if thoroughly cultivated, leave land in good condition for a succeeding crop, and usually pay well enough for a farmer to sell, at a fair profit, a surplus beyond what he needs to eat and to feed.

In 1845 we dug $1,309,000 worth, at 33 cents per bushel: in 1875, at 65 cents per bushel, we had $2,349,815 worth.

TOBACCO.

Tobacco has at times been a very paying crop; and perhaps, if judiciously managed, it might always be so. At any rate, it has brought a large amount of money into some parts of the State.

In 1840 we had but $3,854 worth, at 6 cents per pound: in 1880 we packed 5,369,436 pounds, valued at 13 cents per pound, amounting to $698,805.

The only way in which many farmers can look with favor on tobacco is in following it, after two or three years, with wheat, and stocking down to grass, by which course one can cut forty bushels of wheat to the acre, and three or four tons of hay, for three or four successive years; the heavy manuring and the thorough cultivation which the tobacco receives leaving the land free from weeds, and insuring heavy, clean grain and grass crops for a long time.

Next to our neglect of sheep-raising, our greatest remissness is in not growing wheat, which has gone from 157,923 bushels in 1840 down to 15,768 bushels in 1880, valued at $1.68, as against $1.14 in 1845. By the census of 1880 it seems that we are improving, as we raised over 2,000 bushels more than we did in 1875; but in 1874 the farmers of this Commonwealth sowed 21,351 acres of rye (which yielded but 11¾ bushels to the acre) worth 99 cents per bushel, and only sowed 677¼ acres of wheat (which averaged 20⅓ bushels to the acre) worth $1.68 per bushel. Much of the

rye, to be sure, was sown where it was supposed nothing else would grow, — on light or "plain land," and without grass-seed; but that does not excuse our not growing more wheat, especially where land is to be stocked down to grass or clover, for which purpose it is a better grain, and safer than rye or oats, which are commonly used.

In 1838 the Legislature of Massachusetts, perceiving the decline of wheat-growing within the State, believing that every farming community should to some considerable extent raise its own breadstuffs, and realizing the importance of continuing and encouraging this branch of farm-industry, offered bounties for wheat-growing as follows: "That to every person who shall raise fifteen bushels of wheat shall be paid two dollars, and five cents on each additional bushel, and, for any person who shall raise the greatest quantity on any farm (not less than five hundred bushels), one hundred dollars."

Under the stimulus of that bounty, there were grown, in 1838–9, 108,570 bushels, and, in 1840, 157,923 bushels, averaging sixteen bushels to the acre, which was not only above the average of the country, but was the largest yield of any one of the United States, as was the yield of 1875 of over 20 bushels. Why is it that the 9,670 acres of forty years ago have dwindled down to 677 in 1875? It can be grown, and is, in some parts of the State, and yields and pays better than any other grain-crop.

It costs no more to stock down land with wheat than with rye in the fall, or with oats in the spring: it pays more, and it is a better grain for that purpose.

There is no question but that our home-grown and ground wheat makes better and more nutritious flour than the very white, patent, scoured and bolted wheat of the Western mills, and, for economy and health, should be encouraged here.

Wheat is composed largely of starch (something more than one-half) and gluten (about one-fourth). The gluten is the nutritive part, forming muscle, but it is not white; and Western millers have patented various devices to free the flour from that portion of the grain which shall detract from its superlative whiteness, and they thus eliminate that which is the most nutritious to an extent which our millers at home do not and should not attempt.

It is an unquestioned chemical fact, that wheat, ground

and unbolted, makes the healthiest bread we can eat; but between that and the superfine flour of the West is a true medium of making sweet white flour, retaining the nutritive portion. Many of our best farmers in the western part of the State have never had a barrel of flour in their families that was not grown on their own farms; and they and their wives, and many who have sat at meat and broken bread at their hospitable tables, find it unsurpassed.

In Franklin County one of the leading farmers, who spreads a generous table, has on it bread from ninety bushels of wheat grown on his farm from two acres in 1880, and has recently harvested from four acres a hundred and sixty-eight bushels. Another has often had forty bushels, and for twenty years has grown his own flour with never less than twenty-five bushels to the acre. An honored, white-haired farmer from the hills west of Greenfield may be seen, on some day in early winter, passing through that village on his way to mill, with a wagon-load of wheat from his own farm for his year's supply of flour, as he has done for nearly a half-century with scarcely a failure; and his is usually spring wheat.

It is a creditable fact that Franklin County raises more wheat than all the rest of the State of Massachusetts.

It has never been satisfactorily shown why, in a moderate way, wheat may not, here in the mixed farming of New England, give a fair return.

In looking over the statements of wheat-growers, as returned in our State reports, none appear where the crop was less than thirty bushels to the acre, or the cost of production, including fertilizers, over fifty cents per bushel.

With thirty bushels to the acre, worth a dollar and a half per bushel, and ten dollars for the straw, making fifty-five dollars, and deducting the cost of raising and harvesting at fifty cents per bushel, you have forty dollars net profit on the acre, and your land ready for the grass-crop. In another way of calculating, five bushels of wheat go to a barrel of flour, as is commonly said, though they really overgo: and the farmer who raises thirty bushels of wheat on an acre can have six barrels of prime flour worth, over the cost of milling, thirty-six dollars; six hundred pounds of middlings and bran of the best quality, worth nine dollars; and

the straw, ten dollars; making fifty-five dollars. Deduct fifteen dollars as the cost of production, and the profit of forty dollars remains.

These figures are all moderate, are facts, not fancies; and it does seem that the growing of wheat in Massachusetts is a branch of farm-industry that deserves more attention than it is receiving at the present day.

RYE.

Of rye we had, in 1844, 446,925 bushels, which, at 73 cents per bushel, amounted to $320,033 ; in 1880, 213,716 bushels, valued at $235,087, at $1,10 per bushel, — a loss of $92,346. Probably the increased value of the straw would somewhat reduce this deficiency; but it is undoubtedly true that not so much rye is grown as formerly, not so much eaten in families, nor consumed on the farm.

BARLEY.

In barley, while we show in 1880 an increase of more than 33,000 bushels over 1875, yet it is less by 41,800 bushels than 1845; but, the value being doubled per bushel, the loss is only about $25,000.

BUCKWHEAT.

In buckwheat we have gained 34,833 bushels and about $45,000; its value being 90 cents, as against 47 cents in 1845, and the yield 25,000 bushels larger than in 1875.

DAIRY.

It is, however, in the dairy, that our best show is made. There are no full returns, of the milk produced, in the State census of 1845 or 1855, but there were probably sold in 1845 about 2,855,412 gallons; and, with the valuation at 11 cents per gallon, it would amount to $304,917, beside what was made into butter and cheese.

In 1855, 3,009,916 gallons were sold, at 23 cents per gallon; and, in 1865, 10,079,180 gallons, at 19 cents per gallon. In 1870, we sold 15,284,057 gallons, at 18 cents. In 1875, we made 35,698,671 gallons of milk, at 17 cents, amounting to $5,934,671.

This advance has been made by the improvement in our milch cows, of which we had no more than in 1855, and is

one of the most marked and convincing proofs of the progress we have steadily made in our agriculture in the past forty years. Our cows also have increased in ten years nearly 14,000.

What proportion of this milk is sold, consumed on the farms, or made into butter and cheese, there are no figures to tell with any accuracy, nor can any calculation be made; but in 1845 we made $1,116,709 worth of butter, then worth 15 cents per pound, and of cheese $398,174 worth, at 5 cents per pound. In 1875 we churned butter to the amount of $2,747,848, at 35 cents per pound; and of cheese we made to the amount of $405,293, at 13 cents per pound.

While the statistics show a gross increase of our dairy-products, in forty years, of several millions of dollars, it is impossible, as above mentioned, to state it with exactness, or to apportion the whole product of milk between that sold and what is made into butter and cheese, as some of the earlier returns indefinitely divide them; others simply give them all in gross as dairy-products, or merely the number of pounds of butter and cheese, without values, and with no mention of the milk. Our own last census of 1875, most complete in all other matters, is unfortunately deficient in not giving the amount of milk sold, nor how much is made into butter and cheese.

In 1845 the gross amount of dairy-products is given as	$1,819,800
In 1855 the same is	2,598,664
In 1865 (during the war) it is	4,091,462
In 1875 the whole amount of milk is	5,934,671

But the butter and cheese were made from this milk. Calling three gallons of milk for a pound of butter, and one gallon for a pound of cheese, we find left, in 1875, 10,651,144 gallons to sell, and that the cows of that year gave an average, through the State, of about 1,200 quarts each; while, by the same rule, the cows of 1865 averaged about 700 quarts, and the cows of 1855 about 800.

The largest milk-producing counties are Worcester, Berkshire, Middlesex, and then those counties having in or about them cities or large towns which consume great quantities of that necessary fluid.

The largest butter-making counties are Worcester, Franklin, and Berkshire, which produce more than half the butter made in the State.

Worcester, Berkshire, and Hampden make five-sixths of all the cheese manufactured in the Commonwealth.

With rapid transportation and refrigerator-cars, the great creameries of Iowa, Minnesota, and Wisconsin are passing us in the quality and price of butter; and it behooves us to take the utmost pains with our cows, our milk, and our butter-making, to retain control of the Boston market, for home consumption, and for export. Good cows, good feed, and thorough cleanliness at every step in the manufacture, will secure this.

Without doubt, one of the most prevailing and best credited reasons for believing that agriculture has declined in Massachusetts, is judging from the fictitious stand-point of the very high prices ruling for agricultural products during the late war, and for some time after its close.

Through that fearful strife, when over a million of able-bodied men from the North were changed from producers to consumers, the Government, obliged to maintain them in the field, was, from the inadequate supply of all articles of food and clothing which come from the farm, forced to pay very largely for them; and thus a scale of prices was established through the country, far above the rates which had prevailed before the war, and which we had been accustomed to receive.

These, with the inflation of the currency, induced among us more extended cultivation; and this, with a scarcity of labor, enhanced the cost of all that we produced.

This increased production continued for some years after the war; and, when it declined, prices still were kept up, and it was a long time before they were brought down to *ante bellum* times.

In the long run it was a misfortune for our farmers to have received such high-sounding, paper-money prices, as they did for every thing they made, raised, or grew during this period. A factitious value was created which could not and did not continue very long after the emergency creating it had passed. It was disappointing and hard for farmers to realize this fact, and they did not readily nor cheerfully return to normal prices.

This condition, existing for a period of six or eight years, with a reluctant return to old rates, has given an impression of a general decline in agriculture which is incorrect.

Our animals are finer, our products better, and our crops superior, both in quality, and in the amount of each grown to the acre.

Much of this is due to the perfection in, and the universal use of, our agricultural machines and implements.

Of the number or value of these in use upon our farms, there are no returns back of 1850, where they are put down at $3,209,584; in 1875, at $5,321,168, — a gain of over two millions. All of these, except the simplest, have been brought into use within the past forty years; and beyond these figures it can only be left to the imagination to estimate the benefit we have received from these useful and comfortable aids to our farming.

The land is better tilled with our perfected ploughs, both land-side and swivel, pulverized with the wheel-harrow and the smoothing-harrow, — implements unknown forty years ago. Our corn may be planted and cultivated solely by horse-power, our grains cut and threshed by machines; while with the mower, the tedder, and the horse-rake, we put our hay in our barns in better condition in twelve or thirty-six hours than was formerly done in three days.

Our dairy utensils and implements have wonderfully lightened woman's work in handling milk, butter, and cheese, and are the admiration of all lands.

For winter use we have good machines for threshing our grain, shelling corn, cutting hay, stalks, and roots; while our small tools and implements are incomparably superior, not only to those used by the farmers of a half-century ago, but also to those now in use by any people on the globe.

In our appliances for farming, there is no decline. From want of statistics in earlier years, it is impossible to show the comparative progress we have made in the improvements on our lands by draining, ditching, and reclaiming poor and unproductive land; but the immensity of this is apparent in every town in the State. Nor can we compare the improvements of setting out trees, vines, and fruit-bearing plants, to say nothing of the universally increased disposition to cultivate flowers within and about the farmers' houses, — certainly indicating the growth of cultured and refined tastes.

A farmhouse window filled with blooming plants, or a bright flower-bed before the house (both now so common),

show good taste and thrift within, quite inconsistent with the idea of decline.

The introduction of special fertilizers into our system of agriculture, to supply the want of farmyard-manure where there is a deficiency, and also for appliance in preference to manure for some purposes, must be reckoned among the great improvements of this age.

Less than fifty years ago, the first cargo of guano was brought to this country from the Chincha Islands, — the first special fertilizer used by us, with the exception of a worthless manufacture called poudrette.

Soon after commenced the preparation of special compounds of the chemical constituents which supply plant-food, which has continued with a steady increase to enormous proportions, and which has been of incalculable value in our farming and gardening operations.

The manufacture and introduction of honestly compounded special fertilizers is an immense advance in the agriculture of Massachusetts.

A brief summing-up of the gains and losses in our agricultural productions within thirty or forty years prior to 1875 and 1880, according to the Federal and State census reports, shows an increase in the values, as follows: —

	Increase.		Decrease.
Horses	$4,264,000	Sheep . .	$265,327
Neat-cattle . . .	6,637,297	Wool . .	260,940
Swine	45,000	Wheat . .	21,497
Poultry and eggs . .	1,610,843	Rye . .	92,346
Slaughtered animals, .	250,000	Barley . .	25,778
Dairy produce . .	3,144,055	Broom-corn .	75,000
Hay	6,752,084		
Corn	387,485		$740,888
Oats	7,244		
Potatoes	1,040,785		
Tobacco	694,172		
Buckwheat . . .	45,000		
Orchard products . .	824,014		
Maple sugar and sirup .	100,000		
Small fruits, garden produce, berries, roots, etc.,	3,061,298		
	$28,863,277		
	740,888		
Increase . . .	$28,122,389		

In some of the items, where the last returns have been procured from the census office, the comparisons have been brought down to 1880, and make a most favorable showing of a large increase over 1875, which has necessarily been taken as the basis of most of the prices.

If we had the completed returns of 1880, we should find this amount increased to fully thirty millions.

And when to this are added the millions expended in reclaiming land, in planting trees and vines, in good houses and grand barns, and in improved agricultural implements, machines, and appliances for lightening labor, it would seem that in a material point of view the question, Has agriculture declined, is answered, Most decidedly.

Much of this talk of the decline of our agriculture is engendered by some of those living on poor farms, or in the hill-country, and in regions a little remote from convenient railway-stations and a market, and perhaps themselves lacking in some of the elements which are necessary to success in any occupation. Judging from the scope of their own limited vision, they think that the number of farms, value of farms and farm buildings, and acres of cultivated land, must have been greatly reduced. But let us see how this is.

Comparing again the Federal census from 1850 with the State census, we find that the number of farms has increased from 34,069 in 1850, 35,200 in 1860, 26,507 in 1870, 44,549 in 1875; the average size being 99 acres in 1850, 94 in 1860, 103 in 1870, and 76 in 1875.

The value of farms and farm buildings during the same time has increased from $109,076,347 to $182,663,140, or at nearly the rate of $3,000,000 annually.[1]

If an occasional deserted house or tumble-down barn is pointed out, and cited as evidence of decline, there are to be seen, for every one of those, scores of pleasant, commodious, and attractive farmhouses, and large, handsome, and convenient barns and out-buildings, to prove the negative of any such assertion; and perhaps there could be no more convincing witnesses against the fallacy of that proposition than the hundreds of pretty and comfortable schoolhouses sprin-

[1] In 1850 the average value of the farms was $3,205, and of machines and implements on each farm $94. In 1875 the average value of each farm was $4,100, and of machines and implements on each farm $120.

kled all over the Commonwealth, displacing the old, cold, dreary nurseries of New-England manhood, where, fifty years ago, the youthful blood was chilled over unavailing fires, and quickened by the unfurloughed ferule.

The acres of cultivated land have increased over 31,000 from 1865 to 1875: and although in some of the staple crops the acreage is not as much as it was thirty or forty years ago, yet the yield to the acre of these is much more, which shows in that time an advance of corn from $28\frac{1}{2}$ bushels per acre to $35\frac{3}{4}$; of wheat, from $15\frac{3}{4}$ to $20\frac{1}{2}$; barley, from 20 to $25\frac{1}{2}$; oats, from $21\frac{1}{4}$ to $31\frac{1}{4}$; onions, from 313 to 344; potatoes, from 95 to 108.

All our grain-crops have largely increased in acreage since 1875, — oats, 40 per cent; barley and buckwheat, 75 per cent; and corn, about 88 per cent, or 790,000 bushels more than in 1875.

This often-repeated charge, that the agriculture of Massachusetts has greatly declined, has not facts to support it. It is foolish, and is derogatory to the whole of the citizens of the Commonwealth, as well as to the farmers. It is uttered by those who are ignorant of the condition of our affairs now, as compared with the past, who have never examined nor compared the statistics of the past and the present, and who are so aptly described by a Latin poet and farmer, — himself, fifty years before our Saviour's birth, born and reared on a farm, and afterwards the owner of the famous "Sabine Farm," — that I venture to give his own language: "*Difficilis, querulus, laudator temporis acti*" ("discontented, complaining, and always praising the times that are past").

We have seen, in figures which may not be traversed, what we have lost, and what gained, in our farm productions; and taking the amounts less in 1875 than in 1845, which show all the loss that could be claimed, the single item of the increase in poultry and eggs, or of tobacco alone, out-counts them all; nay, more: in the limited returns accessible for 1880 it appears, that, since the census of 1875, the horses of the State have increased by 9,892; the milch cows, by 26,454; and the sheep, by 7,000; or, according to the valuation of 1875 ($2,953,520), about four times the whole loss from 1845 to 1875. During the same period of five years our grain-crops have increased by $950,219.

If, then, there has been no decline, but an immense advance, in our material prosperity in agriculture, is there any man so bold and reckless as to declare that the farmers of Massachusetts have declined in a social, domestic, and intellectual way?

Fifty years ago the first line was not built of that vast network of railroads which stretches over all portions of our Commonwealth, bringing every man, even from the remotest part of the State, within a half-day's journey of a market, and affording quick and easy intercommunication between every county, giving opportunities for forming and continuing acquaintance, gaining general information, and transacting business unimagined in those earlier days of slow and tiresome locomotion.

Our turnpikes have become highways, and our highways perfected. An agricultural college, the Board of Agriculture, county societies, farmers' clubs and institutes, have been established to enlighten and quicken the minds, and to draw out the experiences, of farmers, by frequent meetings for free discussions, and pleasant interchange of opinions on those subjects that most concern them.

It is less than fifty years since Justus von Liebig first opened the volume of agricultural chemistry for common inspection, followed by his contemporary Boussingault; while Voelcker, Lawes, Gilbert, and Anderson, in the Old Country, and later, in our own State, Dana, Nichols, Sturtevant, Stockbridge, and Goessmann, have been worthy successors and exponents of that science.

The chemistry of agriculture has taught us, first, the importance of draining and subsoiling, loosening and aerating, the hidden depths of the soil, that plants may there find proper moisture and sustenance; it has taught us somewhat the mysteries of plant-life, and how plant-organisms are developed to full maturity; it has taught us respecting the offices of the soil, the rain, the air, heat, and moisture, in accomplishing this work; it has taught us that plants do not obtain all their elements of growth from the mingled rock-dust and humus which constitute soil, but that, wonderful as it may seem, they form from the atmosphere, almost alone, solid forms of plant-organisms; it also teaches us, that, in supplying the food necessary for vegetable growths, different plants require different nutriment.

It has clearly and minutely explained to us the nature of fertilizers, and how they become plant-food, and wherein consists the value of our farmyard-manure, and how it may be supplemented in another form by chemical elements, which, when applied, nature assimilates to the wants of the plant. It has taught, not only how to use these special fertilizers, but also to distinguish between those which are genuine and valuable and those which are fraudulent and worthless.

In a word, agricultural chemistry has done more than any thing else during the past half-century to elevate the hard-working but intelligent farmer from a mere imitator — in his cultivation — of those who went before him, to be a reasoning, thoughtful manager of such elements as are under his control.

Forty years ago how many farmers would understandingly or patiently have endured an essay from a brother farmer, or from one of our teachers, which treated of animal or vegetable physiology, nitrogenous or non-nitrogenous food for stock, of the importance of nitrogen as plant-food, of phosphates or nitrates, of the chemical composition of manure, of the aeration of the soil, and a hundred other such matters now taught to the children in the schools, and applied by the fathers on the farms?

While the acquirement of this scientific knowledge has tended to elevate and expand the ideas of the farmers, improved machinery, as an adjunct, has enabled them to employ more brain-work in the management of their farms, while reducing the amount of the severest physical labor yet to increase their productiveness.

Fifty years ago the farmers cut the ripening grain with the sickle or the cradle. The cheerful clatter of the mowing-machine had never startled the stillness of the early morning on their broad meadows or their well-tilled hillsides: they mowed with the scythe.

> "Each stalwart mower, emulous and strong,
> Whose writhing form meridian heat defies,
> Bends o'er his work, and every sinew tries."

They turned the grass with a fork, and gathered the hay with a hand-rake. They broke the "stubborn glebe" with a hard-running plough, and pulverized the soil by persistent

THE FINANCES OF THE SOCIETIES.

FINANCES OF THE SOCIETIES.

SOCIETIES.	Amount received from the Commonwealth.	Income from permanent fund.	New members and and donations.	All other sources.	Receipts for the year.	Premiums offered.	Premiums and gratuities paid.	Current expenses for the year, not including premiums and gratuities.	Disbursements for the year.	Indebtedness.	Value of real estate.	Value of personal estate.	Permanent fund.
Massachusetts . .	-	-	-	-	-	-	-	-	-	-	-	-	$77,002 47
Essex	$600 00	$1,417 67	$205 75	$2,340 80	$4,564 22	$2,910 00	$1,765 00	$2,660 81	$4,494 81	-	$6,000 00	$17,600 00	23,600 00
Middlesex[1] . .	1,200 00	-	271 60	2,210 40	3,682 00	2,059 50	912 95	2,747 28	3,428 03	$17,720 00	25,000 00	300 00	3,000 00
Middlesex North .	600 00	429 10	97 00	729 87	1,855 97	1,182 00	808 50	1,084 52	1,893 02	1,200 00	20,000 00	-	20,000 00
Middlesex South .	600 00	-	142 80	1,670 10	2,412 90	884 50	339 25	2,039 40	2,377 57	12,000 00	18,000 00	-	18,000 00
Worcester . . .	600 00	594 00	35 00	1,170 00	2,399 00	9,000 00	7,500 00	2,399 00	10,000 00	37,000 00	100,000 00	5,000 00	63,000 00
Worcester West .	600 00	-	50 00	1,351 66	2,001 66	1,393 75	1,118 55	657 64	2,141 26	1,494 93	11,600 00	750 00	11,600 00
Worcester North .	-	-	-	-	-	-	-	-	-	-	-	-	-
Worcester No.-west,	600 00	-	102 50	2,357 62	3,060 12	1,686 75	1,102 30	1,384 85	3,087 15	6,525 00	12,500 00	1,460 15	7,435 15
Worcester South .	600 00	988 02	103 00	4,668 35	4,771 35	1,834 00	1,483 20	1,572 85	4,795 00	1,000 00	13,500 00	1,000 00	-
Hampshire, Franklin, and Hampden	600 00	98 50	178 00	1,636 46	2,512 96	1,260 75	712 50	1,674 09	2,386 59	6,716 66	7,800 00	236 37	8,036 37
Hampshire . .	600 00	-	104 13	596 73	1,300 86	760 00	649 25	665 96	1,315 21	779 52	4,100 00	150 00	3,470 48
Highland . . .	600 00	40 00	73 00	1,340 94	2,059 94	890 30	666 80	535 22	2,059 94	-	3,000 00	700 00	3,700 00
Hampden . . .	600 00	-	10 00	721 06	1,331 06	1,591 25	587 32	773 56	1,360 88	-	-	-	-
Hampden East . .	600 00	-	99 94	745 68	1,445 62	1,049 00	836 05	830 99	1,667 04	-	5,000 00	-	5,000 00
Union . . .	600 00	-	174 84	1,279 39	2,054 23	1,104 95	739 16	876 71	1,615 87	-	5,200 00	2,150 00	7,350 00
Franklin . . .	600 00	110 00	105 00	1,438 17	2,253 17	819 25	749 50	657 58	2,301 00	1,000 00	10,000 00	1,400 00	11,400 00
Deerfield Valley .	600 00	-	282 75	860 88	1,743 63	637 00	643 55	1,099 01	1,743 63	800 00	8,070 00	50 00	8,070 00
Berkshire . . .	600 00	373 45	358 00	2,628 28	3,959 73	3,273 00	2,729 75	1,245 52	3,665 97	-	6,000 00	800 00	6,000 00
Hoosac Valley . .	600 00	-	333 00	2,809 35	3,742 35	1,567 50	1,238 35	1,136 97	3,568 47	4,500 00	12,500 00	450 00	-

Housatonic . .	600 00	30 37	205 67	4,934 05	5,760 59	3,585 00	2,928 00	3,076 61	6,004 61	-	8,500 00	11,206 13	19,706 13
Bristol . . .	600 00	-	222 10	7,519 09	8,341 19	4,000 00	3,415 40	4,871 41	9,286 81	8,000 00	50,000 00	300 00	-
Plymouth . . .	600 00	225 00	1,771 00	4,659 62	7,255 62	3,115 00	2,426 15	4,296 51	6,722 66	7,467 04	43,000 00	2,000 00	-
Hingham . . .	600 00	-	167 00	2,098 38	2,865 38	1,252 75	582 35	2,027 08	2,909 43	2,800 00	16,000 00	2,000 00	15,200 00
Marshfield . . .	600 00	-	65 00	1,716 70	2,436 70	1,233 00	698 63	1,560 88	2,259 51	3,900 00	12,056 92	1,592 78	9,749 70
Barnstable . .	600 00	16 00	121 20	969 54	1,706 74	1,129 00	766 40	1,018 42	1,784 82	425 00	5,000 00	500 00	5,075 00
Nantucket . . .	600 00	40 00	22 00	396 70	436 70	1,173 00	580 96	455 25	941 06	588 00	3,200 00	200 00	2,612 00
Martha's Vineyard .	600 00	101 88	34 00	561 24	1,297 12	839 00	649 86	377 78	1,027 64	-	2,200 00	1,800 00	3,900 00
Amesbury and Salisbury . .	-	40 00	59 00	8 00	312 06	300 00	206 75	89 68	296 43	-	-	500 00	1,002 32
Worcester So.-east .	-	-	-	-	-	-	-	-	-	-	-	-	-
Totals . . .	$16,200 00	$4,503 99	$5,393 28	$53,425 06	$77,562 87	$50,530 25	$36,836 48	$41,815 58	$85,134 41	$113,916 15	$408,226 92	$52,145 43	$333,909 62

[1] Years 1880 and 1881.

PERMANENT FUND, — HOW INVESTED.

MASSACHUSETTS. — In bank-stock, bonds, and mortgages.

ESSEX. — In real estate, bank-stock, United-States and other bonds, library, and exhibition fixtures.

MIDDLESEX. — In land and buildings.

MIDDLESEX NORTH. — In land and buildings.

MIDDLESEX SOUTH. — In land, buildings, sheds, stalls, pens, and track.

WORCESTER. — In real estate.

WORCESTER WEST. — In real estate and fixtures.

WORCESTER NORTH-WEST. — In land, buildings, personal property, and $960.15 cash.

WORCESTER SOUTH. — In land, buildings, cattle-sheds, and track.

HAMPSHIRE, FRANKLIN, AND HAMPDEN. — In real estate, personal property, and cash.

HAMPSHIRE. — In real estate.

HIGHLAND. — In real estate, savings-bank notes, and cash.

HAMPDEN EAST. — In park, hall for exhibition, and cattle-pens.

UNION. — In land and buildings, and $1,118.95 cash.

FRANKLIN. — In land, buildings, and ten shares Franklin County bank-stock.

DEERFIELD VALLEY. — In real estate.

BERKSHIRE. — In real estate.

HOOSAC VALLEY. — In real estate and personal property.

HOUSATONIC. — In real estate, personal property, notes of members, railroad bonds, and cash.

BRISTOL. — In real estate and personal property.

PLYMOUTH. — In real estate, furniture and fixtures, and cash.

HINGHAM. — In land, buildings, furniture, and fixtures.

MARSHFIELD. — In land, buildings, and personal property.

BARNSTABLE. — In real estate and United-States bonds.

NANTUCKET. — In land and buildings.

MARTHA'S VINEYARD. — In land and buildings, and notes of members.

ANALYSIS OF PREMIUMS AND GRATUITIES AWARDED.

SOCIETIES.	Total am't offered for management and improvement of farms, orchards, etc.	Total amount paid for management and improvement of farms, orchards, etc.	For neat and dairy stock.	For horses.	For all other farm-stock.	Total amount offered for live-stock.	Total amount paid out for live-stock.	For cereals and seed.	For roots and vegetables.	Total amount offered for grain and root crops.	Total amount paid out for grain and root crops.	For fruits, flowers, etc.	For dairy-products.	For bread, honey, and preserved fruits, etc.	Total amount paid out under the head of farm-products.
Massachusetts .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Essex . . .	$335 00	$132 00	$472 00	$232 00	$155 50	$1,120 00	$805 00	$40 00	$138 00	$160 00	$40 00	$341 00	$53 00	$24 00	$806 00
Middlesex . .	159 00	46 00	122 00	85 00	152 50	849 00	359 50	2 00	71 00	122 00	73 00	168 00	-	42 00	283 50
Middlesex North,	-	-	184 00	148 00	107 75	608 00	415 50	17 50	55 00	141 00	111 00	195 25	13 00	59 00	393 00
Middlesex South,	81 00	36 00	105 00	56 00	74 00	449 00	185 00	8 50	13 00	129 75	21 50	41 10	6 00	4 00	94 05
Worcester . .	-	-	1,448 00	463 00	175 00	4,591 00	2,086 00	44 00	28 00	180 00	60 00	384 00	45 00	36 00	-
Worcester West,	80 00	15 00	282 50	118 00	71 50	523 00	475 00	3 50	11 50	62 50	14 50	38 75	29 00	12 00	171 75
Worcester North,	24 25	24 25	138 50	67 50	59 50	421 00	219 50	37 00	13 75	50 50	49 75	96 25	14 50	20 00	163 50
Worcester N.-W.	22 00	20 00	219 00	124 00	106 75	796 75	415 81	51 00	21 00	110 00	71 66	47 50	15 00	12 00	140 15
Worcester South,	100 00	-	268 00	646 00	59 10	1,339 00	1,119 10	27 00	15 75	117 00	117 00	60 25	32 00	23 00	218 75
Hampshire, Franklin, and Hampden	56 00	18 00	208 00	133 00	150 00	591 00	465 00	151 00	58 00	238 00	95 50	56 25	36 00	18 00	188 00
Hampshire . .	-	-	121 00	137 00	129 00	431 00	387 00	33 00	65 00	114 00	98 00	73 00	8 50	11 50	191 00
Highland . .	90 00	80 00	165 75	132 00	68 00	531 25	365 75	13 50	20 50	38 00	34 00	17 00	20 50	6 30	77 80

Hampden . .	180 00	9 50	126 00	89 00	114 00	791 50	209 50	14 50	9 00	37 75	12 89	74 75	5 00	14 50	67 91
Hampden East .	119 00	20 00	54 00	99 00	85 00	470 00	338 50	21 50	19 25	77 00	42 00	49 00	12 75	8 00	109 75
Union . . .	16 00	4 50	168 00	114 00	159 00	550 00	433 75	19 00	16 75	56 00	31 50	22 65	15 50	7 00	78 15
Franklin . .	-	-	137 00	75 00	279 00	491 00	430 75	5 00	23 50	42 50	28 50	112 75	20 00	20 25	175 00
Deerfield Valley,	-	-	174 00	119 00	120 00	426 00	413 00	29 75	13 50	62 25	46 25	44 50	19 90	16 25	180 15
Berkshire . .	141 00	135 00	416 00	231 00	295 00	1,296 00	941 00	212 00	132 00	302 00	282 00	141 00	53 00	45 50	583 50
Hoosac Valley .	60 00	50 00	121 00	177 00	222 00	656 00	518 00	138 50	71 25	247 00	209 75	87 75	48 50	46 00	392 00
Housatonic . .	228 00	200 00	461 00	236 00	294 00	1,901 00	1,428 00	412 00	131 00	598 00	572 00	207 00	63 00	61 00	903 00
Bristol . . .	215 00	113 00	509 00	184 00	222 50	1,550 50	900 00	19 00	71 25	260 00	76 25	139 00	30 00	19 75	279 00
Plymouth . .	-	-	437 36	153 00	193 00	955 00	686 36	86 00	81 00	144 00	144 00	115 00	55 00	144 50	-
Hingham . .	134 00	20 00	127 00	51 00	115 65	639 25	293 65	-	26 00	139 00	26 00	111 40	6 50	23 20	167 10
Marshfield . .	123 00	33 00	202 00	64 50	81 00	426 50	347 50	28 00	55 75	94 00	83 00	126 15	23 00	19 65	252 65
Barnstable . .	156 00	39 00	122 00	40 00	138 25	310 00	300 25	-	49 50	197 00	49 50	83 25	15 00	27 00	174 75
Nantucket . .	51 00	-	160 50	86 00	46 25	587 00	274 75	23 00	34 70	111 00	23 00	40 00	9 00	9 00	119 85
Martha's Viney'd,	48 00	10 00	112 00	59 00	123 50	381 00	294 50	51 50	54 50	165 00	82 00	44 00	9 00	28 25	163 25
Amesbury and Salisbury	-	-	-	-	2 50	-	-	12 00	34 50	-	-	84 75	1 00	5 50	137 75
Worcester S.-E. .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Totals . .	$2,418 25	$1,005 25	$7,060 61	$4,119 00	$3,759 25	$23,680 75	$15,107 67	$1,499 75	$1,333 45	$3,995 25	$2,494 55	$3,001 30	$658 65	$763 15	$6,511 31

ANALYSIS OF PREMIUMS AND GRATUITIES AWARDED. — *Concluded.*

MISCELLANEOUS.

SOCIETIES.	For agricultural implements.	Offered for raising forest-trees.	For experiments on manures.	Amounts awarded for objects strictly agricultural not already specified.	Amount awarded and paid out for trotting-horses.	For objects not strictly agricultural: domestic manufactures.	Number of persons who received premiums and gratuities.
Massachusetts . .	-	-	-	-	-	-	-
Essex	$60 00	$30 00	$25 00	-	-	$204 50	$587 00
Middlesex . . .	34 00	50 00	-	-	$500 00	116 50	137 00
Middlesex North . .	-	-	-	-	-	1 50	136 00
Middlesex South . .	7 50	45 00	-	-	250 00	50 75	123 00
Worcester . . .	87 00	-	-	-	1,450 00	538 50	357 00
Worcester West . .	-	30 00	10 00	-	459 00	-	213 00
Worcester North . .	13 75	25 00	-	-	66 00	174 50	268 00
Worcester North-west .	3 00	30 00	-	-	495 00	54 15	198 00
Worcester South . .	50	35 00	-	-	490 00	16 00	165 00
Hampshire, Franklin, and Hampden .	17 00	20 00	-	-	454 00	73 75	174 00
Hampshire . . .	-	16 00	-	-	155 00	71 25	154 00
Highland . . .	2 00	-	-	-	35 00	106 25	208 00
Hampden . . .	22 00	30 00	15 00	-	235 00	64 00	127 00
Hampden East . .	17 00	25 00	-	-	300 00	50 80	148 00
Union	5 20	-	-	$6 95	128 00	94 20	215 00
Franklin	-	10 00	-	-	575 00	78 00	225 00
Deerfield Valley . .	-	-	-	-	-	50 40	271 00
Berkshire . . .	58 00	-	-	-	590 00	407 25	537 00
Hoosac Valley . .	17 00	-	10 00	24 25	630 00	237 10	281 00
Housatonic . . .	-	-	-	-	445 00	406 00	455 00
Bristol	49 00	23 00	60 00	-	1,514 00	461 90	440 00
Plymouth . . .	22 00	60 00	-	18 00	852 00	212 29	438 00
Hingham . . .	3 00	50 00	5 00	-	-	93 60	276 00
Marshfield . . .	-	50 00	-	-	164 00	122 02	460 00
Barnstable . . .	-	7 00	-	-	85 00	167 40	249 00
Nantucket . . .	-	13 00	-	-	-	92 62	250 00
Martha's Vineyard .	-	11 00	10 00	-	-	176 11	175 00
Amesbury and Salisbury . . .	7 00	10 00	-	-	-	-	70 00
Worcester South-east .	-	-	-	-	-	-	-
Totals . . .	$424 95	$570 00	$135 00	$49 20	$9,872 00	$4,121 34	$7,337 00

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HAMPSHIRE, FRANKLIN, AND HAMPDEN.

President — L. W. WEST of Hadley.
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President — C. B. MAYHEW of Charlemont.
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PLYMOUTH.

President — JOHN LANE of East Bridgewater.
Secretary — LAFAYETTE KEITH of Bridgewater.

HINGHAM.

President — EBED L. RIPLEY of Hingham Centre.
Secretary — WILLIAM H. THOMAS of Hingham.

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Secretary — F. B. GOSS of Barnstable.

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President — DANIEL ROUND of Nantucket.
Secretary — JOHN F. BROWN of Nantucket.

MARTHA'S VINEYARD.

President — EVERETT A. DAVIS of Tisbury.
Secretary — B. T. HILLMAN of Chilmark.

AMESBURY AND SALISBURY.

President — J. HENRY HILL of Amesbury.
Secretary — A. H. FIELDEN of Salisbury.

AGRICULTURAL EXHIBITIONS, 1882.

ESSEX, at *Haverhill*, Sept. 26 and 27.
MIDDLESEX, at *Concord*, Sept. 26, 27, and 28.
MIDDLESEX NORTH, at *Lowell*, Sept. 26 and 27.
MIDDLESEX SOUTH, at *Framingham*, Sept. 19 and 20.
WORCESTER, at *Worcester*, Sept. 5, 6, 7, and 8.
WORCESTER WEST, at *Barre*, Sept. 28 and 29.
WORCESTER NORTH, at *Fitchburg*, Sept 26, and 27.
WORCESTER NORTH-WEST, at *Athol*, Oct. 3 and 4.
WORCESTER SOUTH, at *Sturbridge*, Sept. 14 and 15.
WORCESTER SOUTH-EAST, at *Milford*, Sept. 26, 27, and 28.
HAMPSHIRE, FRANKLIN, and HAMPDEN, at *Northampton*, Oct. 4, 5, and 6.
HAMPSHIRE, at *Amherst*, Sept. 21 and 22.
HIGHLAND, at *Middlefield*, Sept. 14 and 15.
HAMPDEN, at *Holyoke*, Sept. 26, 27, and 28.
HAMPDEN EAST, at *Palmer*, Sept. 19 and 20.
UNION, at *Blandford*, Sept. 20, 21, and 22.
FRANKLIN, at *Greenfield*, Sept 28 and 29.
DEERFIELD VALLEY, at *Charlemont*, Sept. 21 and 22.
BERKSHIRE, at *Pittsfield*, Oct. 3, 4, and 5.
HOOSAC VALLEY, at *North Adams*, Sept. 19 and 20.
HOUSATONIC, at *Great Barrington*, Sept 27, 28, and 29.
BRISTOL, at *Taunton*, Sept. 26, 27, and 28.
PLYMOUTH, at *Bridgewater*, Sept. 20, 21, and 22.
HINGHAM, at *Hingham*, Sept. 12 and 13.
MARSHFIELD, at *Marshfield*, Sept. 13, 14, and 15.
BARNSTABLE, at *Barnstable*, Sept. 26 and 27.
NANTUCKET, at *Nantucket*, Sept. 6 and 7.
MARTHA'S VINEYARD, at *West Tisbury*, Oct. 3 and 4.
AMESBURY and SALISBURY, at *Amesbury*, Sept. 21 and 22.

APPENDIX.

APPENDIX.

I.

THE CULTURE OF CORN.

BY J. B. LAWES, LL.D., F.R.S.

The Eighth Annual Report of the New Jersey State Board of Agriculture contains a paper by Mr. Henry Stewart, upon a subject which has occupied my attention for a great number of years, and which is now coming to the front as a great question of economy in commercial agriculture. It may be described briefly as "Freight *versus* Artificial Fertility."

Mr. Stewart says, "It has been the fashion to believe, or at least to say, that the farms in the eastern parts of the country are exhausted, that agriculture here is in danger of ruinous competition from the newer lands of the West, and that it is cheaper to buy Western corn than to grow it in the East." And he goes on to "show the fallacy of such an idea as this" by the following figures: —

	Cents.
Freight on a bushel of corn from Chicago to New York . . .	30
Cost of fertilizer to produce a bushel of corn	9

The question here raised is not only one of importance with reference to the East and West of the United States, but also as regards the United States and Great Britain; for, though it is true that we do not grow corn, it is also true that our wheat is gradually being displaced by the cheaper-grown wheat of the States.

Mr. Stewart goes on to say, "Recent investigation and past experience have shown, that while wheat requires from one-half to full quantity of all the nitrogen to be supplied in a fertilizer, depending upon condition of the soil, corn, on the contrary, requires, even on comparatively poor soils, only about one-fourth the nitrogen to be supplied, as compared to what the crop contains."

It would be very joyful news to our farmers in Great Britain, if I could assure them that wheat requires only "from one-half to full quantity of all the nitrogen" contained in the crop to be applied in manure, or, in other words, that by the application, at the most, of one pound of nitrogen in manure, a pound could be recovered in the produce. So far, however, from my being able to accept this statement, I feel no hesitation in saying that whatever may be the nature of the "recent experiments and past experience" to which Mr. Stewart refers, if they assert, as a general agricultural fact, that the application of half a pound to a pound of nitrogen in manure will produce one pound of nitrogen in a crop of wheat, or that a quarter of a pound of nitrogen in manure will produce one pound of it in corn, they are based upon error. The only manner in which such a result might possibly be arrived at would be by the continuous growth of wheat or corn by means (1) of a mineral manure alone, and (2) by the same manure combined with salts of ammonia, if this were done with very great care, and for a sufficiently long period; although I should even then expect more than a pound of nitrogen would be required to produce one pound of that substance in increased growth, and that more nitrogen would be recovered by the corn than by the wheat.

Mr. Stewart says, further, that Charles V. Mapes is opposed to my idea that corn should be placed in the list of grain-crops which require to be supplied with a surplus of nitrogen, but has insisted that it should be classed with clover and the leguminous crops, which yield larger quantities of nitrogen in their product, but require a very inconsiderable supply.

The statement that corn yields large quantities of nitrogen, like the leguminous crops, is somewhat inconsistent with the table given by Mr. Stewart on page 46 of the report, which shows that corn contains, not only less nitrogen than the leguminous crops, but even less nitrogen than wheat. My object, however, is not to find fault with Mr. Stewart's statements, but to endeavor to correct what I consider to be erroneous in them.

First, then, with regard to corn. That it is a graminaceous plant, and possesses all the properties of that order, I have not a shadow of doubt. All the plants containing large

quantities of silica in the ash possess properties in common, one of which is, that, when liberally supplied with nitrogen, they are capable of outgrowing and overpowering all other species of plants. It is quite true that corn is less dependent upon an artificial supply of nitrogen than wheat, oats, or barley, and the reason for this fact I have frequently pointed out: viz., that, after the other crops are ripe, corn continues its growth during the exact period when the liberation of nitric acid in the soil is most active; and it is this circumstance that enables the United-States farmer to sell corn so much cheaper than wheat.

At Rothamsted we have abundance of evidence to show how large is the quantity of nitric acid liberated during the summer months. For example: the water collected from the drains of our experimental wheat-field in July contained no nitric acid; while the soil of the adjoining field, where no crop was grown, contained in September as much nitric acid as would have supplied the nitrogen contained in fifty bushels of corn. The United-States farmers are now embarking largely in the use of artificial manures, and therefore may possibly be glad to hear the views of one who has been studying their properties for more than forty years.

First, they will find a very great difference between the amount of ingredients which is supplied in a manure and that obtained in the produce; then two of the ingredients generally supplied in manure — viz., phosphoric acid and potash — enter into very fixed compounds with the soil, and are only recovered over long periods of time. In confirmation of this fact, I may say, that, at Rothamsted, we are at the present moment taking up in our wheat-crop phosphoric acid and potash which were applied thirty years ago. Some considerable addition, therefore, in the shape of interest, must be charged on the cost-price of these substances by the farmer who employs them as a manure. With regard to nitrogen the case is different. It appears probable that nitrogen, applied either as ammonia or nitric acid, does not permanently enter into any fixed combination in the soil, unless it has become a part of living vegetation.

And it may be considered an established fact, that, wherever nitrogen is used as a manure, there will be a considerable loss of the amount applied, although the amount of such

loss will vary with the seasons and other causes at present unknown. In consequence of the severe competition to which the British farmer is now exposed, the question of artificial fertility has recently been occupying my attention; and I have come to the conclusion, that, as artificial manures can be purchased quite as cheaply in this country as in the United States, the crop grown by their aid cannot be produced more cheaply in one country than in the other. What we are suffering from in Great Britain is the competition of crops grown by means of natural fertility, which is cheaper than the fertility that can be supplied in any other form. The views of Mr. George Ville with regard to the sources of nitrogen, and the properties possessed by the various crops for gathering it from the atmosphere, appear to have found much favor in some parts of the United States. We have not thought it necessary to bring forward any formal evidence to disprove these views; but I may say, that, as expressed by Mr. Ville, they are entirely opposed to the facts that have been established by the result of the experiments at Rothamsted.

THE CULTURE OF CORN.

MR. H. STEWART'S REPLY TO DR. J. B. LAWES OF ROTHAMSTED.

When I complied with the request of the secretary of the New Jersey State Board of Agriculture to give him my views upon the culture of corn, for publication in the Annual Report of the Board, I little expected that it would bring me into conflict with the world-renowned agricultural chemist and experimenter, Dr. J. B. Lawes. But that I feel some confidence in the truth of my views, and perceive from my point of view that they do not conflict very much, if at all, with those of Dr. Lawes, and that he may, perhaps, miss some important element in this question through want of familiarity with this especially American crop, under its special characteristics in American fields, and under some special conditions, I should scarcely care to discuss this question under the certain disadvantages which Dr. Lawes's greatly superior position throws upon me. I would take this opportunity of acknowledging very gratefully the obligations under which, in common with the many American admirers and students of

the doctor, I have been placed for the fund of information derived from his elaborate experiments and his life's work. We can never too highly appreciate the services he has conferred upon American agriculture; and I am not without some hope that perhaps we in America may some day be able to add something to the great mass of information which has been gathered up at Rothamsted, through our investigations here, under somewhat different circumstances of climate, soil, and crops.

On careful study of Dr. Lawes's communication (see "Rural New-Yorker" of July 2), I must confess that I fail to see any serious point of difference between his views and mine in regard to this question. I don't wish to discuss it in regard to wheat, because I have not given so much attention to wheat-growing as to corn-growing, and confess, that, so far as regards the former crop, I have not yet been able to produce it here so cheaply as I could buy the Western grain; and I doubt very much if we Eastern farmers can compete in wheat production with the West any better than the English farmers can. But I would like to say, that I do not think it depends altogether upon the supply of nitrogen in the soil; that it is not so much a question of fertility as of cheapness of culture. Here in the East our lands cost too much, and our farms are not large enough for the use of the labor-saving implements and machines; so that the cost of a crop of even forty bushels of wheat per acre is not repaid by the price fixed by the cost of the smaller crop of eighteen or twenty bushels grown in Minnesota or Dakota. The very same difficulty exists in England as regards this crop, but with regard to corn this difficulty is greatly lessened. Corn cannot be grown and harvested as cheaply as wheat in the West. The Western corn must be cut and shocked and husked by hand, and at the same cost as in the East; so that the relative disability of the Eastern farmer is not so great as in the case of wheat. It is therefore wholly a question of fertility with corn; while the element of labor enters into the question as regards wheat, to the greater detriment of the Eastern-American and the English farmer. Then, if the cost of the artificial fertilizer required to produce a bushel of corn in New Jersey is less than the freight on it from Chicago, I hope to be able to compete successfully

with the Iowa and Illinois farmer in growing corn. It rests wholly on this point; and, in my paper referred to by Dr. Lawes, I made this my chief point.

My experience in this respect has been limited to a few years, during which I have been growing corn repeatedly with artificial manures. I am not in a position to say how much nitrogen is naturally contained in my soil, which is poor, and had been badly farmed by former owners; but I suspect it is very little. The nearest approach to a knowledge in this respect is the fact, that on part of a field planted with corn, and left without any manure or fertilizer, the crop produced did not bear one sound ear: there were some small stalks and poor nubbins, but not one good ear, on a strip four rods wide through the field. This field (two acres), manured with six hundred pounds of the Mapes corn-manure (containing twenty-three pounds and a half of nitrogen) per acre, gave me ninety-eight bushels of shelled corn containing about eighty-eight pounds of nitrogen per acre. A plot of one-sixth of an acre in another field, manured in precisely the same manner, gave twenty-five bushels and eight pounds of shelled corn, equivalent to a hundred and fifty and six-sevenths bushels per acre. Here was presented a serious problem, and one upon which, it may be easily perceived, depends a most important sequence for the Eastern farmers, who are confronted with a harassing, if not ruinous competition with Western farmers. This, with some repeated crops, not grown experimentally, but in ordinary farm-work, make up the sum of my personal experience.

With this there are many similar experiences of others, reference to which may, perhaps, go no farther than the crops grown on the Rural Farm, a large number of experiments collated by Professor Atwater, and several competitive crops grown by farmers and farmers' boys. These all showed a large product grown, while some of them showed a seriously injurious effect from an excess of nitrogenous manures. Now, there seems to be but one explanation for these facts; and that is, that corn is able to avail itself of a supply of nitrogen from some occult source, when it is sufficiently provided with potash and phosphoric acid. What this source is, I do not attempt now to question. The corn gets the nitrogen, that seems certain: and I infer from Dr.

Lawes's communication, in the "Rural New-Yorker" of July 2, that he and I do not differ in the least as regards this bare fact; for he says, "The only manner in which such a result — viz., that a quarter of a pound of nitrogen in manure will produce a pound of it in corn — might possibly be arrived at would be by the continuous growth of corn by means (1) of a mineral manure alone, and (2) by the same manure combined with salts of ammonia, if this were done with very great care and for a sufficiently long period." Further he says, "More nitrogen would be recovered by the corn than by the wheat."

Now, if I have said any more than what this purports to mean, and Dr. Lawes will allow me, I will withdraw all beyond that, and rest my case upon it. That includes every point I wish to make; for the whole sum of my argument is, that the Eastern farmer, by the perfectly right employment of a quarter of a pound of nitrogen, can recover one pound of it in his corn-crop, if he will only give enough potash and phosphoric acid. In discussing the question of the culture of corn in my paper, I considered it solely in its practical bearings, and did not give much attention to its relative character as compared with clover. But if the above admission of Dr. Lawes is correctly quoted, it certainly seems that it must also be admitted that "corn should not be placed on the list of grain-crops which require to be supplied with a surplus of nitrogen, but rather classed with clover and the leguminous crops, which yield larger quantities of nitrogen in their product, but require an inconsiderable supply." And why not? Consider the season of growth and of the maturity of corn. It occupies a period of the year marked by numerous thunder-showers and a torrid temperature, when the production of nitric acid is known to be greatly in excess of that at any other season, and probably, if not certainly, greater than the product of the whole of the rest of the year; while wheat is mature and ready for harvest before the hot weather fairly begins. Corn, in fact, is a tropical plant, and cannot be justly compared with wheat, oats, and barley, which thrive in the cooler parts of the temperate zone, and is, therefore, as Dr. Lawes admits, "less dependent upon an artificial supply of nitrogen than wheat, oats, or barley." Now,

wherein do we differ in respect to the character of corn as a gatherer of natural nitrogen? I have read with great care all that Dr. Lawes has written in criticism of my paper; but I leave it with the satisfaction of believing that Dr. Lawes really agrees with my views, or, I would rather say, that my views appear to be based on a true understanding of Dr. Lawes's teachings, to which I confess I am indebted for the most of my opinions and beliefs on this subject. I disclaim any desire to stand in the relation of a disputant with Dr. Lawes. I rather claim the relation of a disciple, and recognize him as my apostle and authority in this investigation, and shall rejoice if it may induce him to study still more closely the subject of American corn-culture, in connection with our peculiar climate, and our enforced necessity for mineral fertilizing, with continuous cropping to a great extent.

In conclusion, I would say that I am much pleased to have so favorable an opinion in regard to the permanence of mineral fertilizers from Dr. Lawes, when he says that "phosphoric acid and potash enter into fixed compounds with the soil, and are only recovered over long periods of time." American farmers can scarcely have any more encouraging evidence of the permanence of artificial fertilizers than the fact, that at Rothamsted the potash and phosphoric acid applied thirty years ago are still showing their effects upon the crops. In my attempts to grow corn continuously (and chiefly with artificial manures), I have already had evidence of the same fact; and if the most costly ingredient of these fertilizers, viz., nitrogen, is required only in the small proportion admitted by Dr. Lawes, I can see my way clearly to grow corn cheaper than I can buy it from Western farmers, and either feed it in my dairy, or dispose of it at a profit.

THE NITROGEN SUPPLY

J. B. LAWES, LL.D., F.R.S.

At Rothamsted, in the middle of May of the present year, I planted a few seeds of corn, which I had received from a gentleman living in Baltimore, upon that portion of my land which has grown a permanent wheat-crop for forty years without the application of any manure.

In the adjoining field, which is under experiment with permanent barley, potatoes, and leguminous crops, I planted about a hundred seeds, placing three together, and allowing them the space of a square yard or more from which to collect their food.

The plot of ground upon which they were planted is outside the portion of the field under experiment: it certainly has received no dung for the last thirty years, and may be described as a piece of waste land which has been ploughed with the rest of the field, but has not been cropped, though vegetation has sprung up principally in the form of thistles or annual weeds.

My object in sowing the corn was a very simple one: I wished to ascertain whether the color of the plant, under different foods, corresponded with that of the various cereal crops which we have under experiment.

At the period at which I am writing (Aug. 22) the corn upon the unmanured wheat-land is only one foot high: there is no leaf that is one inch in width, and the color is yellow, or a yellowish-green.

In the adjoining field some of the plants are between four and five feet high, while the leaves are three inches and a quarter wide, and of a very dark, rich green: other plants, although growing and luxuriant, are much paler in color. In this field I have used mineral manures alone, and mineral manures with nitrates.

In the same field with the corn, and close to it, there are fifteen different sorts of leguminous crops growing: they are all manured with (1) various mineral manures alone, and (2) with the same minerals, and, in addition, nitrates or salts of ammonia.

Here we have no changes in the color of the plants due to the influence of the various manures: there are none of those varieties of tint, from a yellowish-green to a greenish-blue (which in the evening appears almost black), that we find in some of our graminaceous crops under experiment. A practised eye might detect, in some cases, a brighter and more healthy green; but that is all.

So far as the corn is concerned, by a comparison of the produce grown on the permanently unmanured land with that grown on the field supplied with minerals, and nitrates

or salts of ammonia, it is evident that the plant has profited largely by the application of the manures. At the same time, while I think that corn, in common with the other cereal crops, is dependent upon a liberal supply of nitric acid *in the soil*, I must not, in saying this, be supposed to advocate its application artificially. I quite agree with Mr. Stewart in thinking that mineral manures alone should be used, or mineral manures with the addition of a small quantity of nitrogen, so long as they enable the farmer to grow a hundred bushels of corn, or even a much smaller crop than that, per acre.

The only difference between Mr. Stewart and myself is this: I think that it is to the soil, rather than to the atmosphere, that we must look for the supply of nitrogen; while Mr. Stewart's view is, that the poverty of his soil does not admit of so large a supply being yielded.

This question can only be set at rest by the continuous growth of corn under mineral manures alone; and, even under such circumstances, many years might elapse before satisfactory conclusions could be drawn. I have more than once, when writing upon American agriculture, pointed out the immense advantage which United-States farmers possess over ourselves and others who live in climates not suitable for the growth of cereal crops.

It is quite true that the United-States farmer is fully aware of this advantage, and does not require to have it pointed out by me; but, at the same time, I may possibly, by the aid of science, help him to understand why it is that he can grow a much larger crop of corn than he can of any of the other grain-crops, and further, when his land is more or less exhausted, why mineral manures will be more effectual when applied to the corn than when applied to other grain-crops.

At Rothamsted we are now engaged in writing upon the subject of rain-water and drainage; and in the "Journal of the Royal Agricultural Society," now being printed, will be found an account of the composition of rain-water passing through an uncropped soil.

I abstain from entering upon any question with regard to the *source* of the nitrogen which we find in our drainage-water, and will merely point out that it could not have been obtained from the atmosphere by plants, as the soil was kept free from vegetation.

II.

NINETEENTH ANNUAL REPORT OF THE MASSACHUSETTS AGRICULTURAL COLLEGE, January, 1882.

To his Excellency the Governor and the Honorable Council.

The Trustees of the Massachusetts Agricultural College, in compliance with the provisions of law, herewith present their annual report. During the year they and their college officers have made the most strenuous efforts to continue and maintain the established system in all departments, and, considering the difficulties of the present situation, with a good degree of success. By assigning extra work to the professors, and keeping their salaries at the lowest point possible without losing their services; by refusing all appropriations for investigations and improvements on the estate; by con fining all our operations to those of imperative necessity, and the practice of rigid economy in these, — we have succeeded in keeping our expenses within our income, and making sundry needed repairs on the buildings. The work of the farm has been directed to ordinary crop operations, with the exception of ploughing and reseeding some portions of the pasture for the purpose of increasing the quantity and improving the quality of its grasses. The area in tillage was forty-seven acres: viz., Indian corn, twenty acres, yielding eighteen hundred bushels of ears and forty-five tons of fodder; rye, twelve acres, yielding a hundred and eighty bushels of grain and fifteen tons of straw; oats, eight acres, yielding four hundred bushels of grain and fourteen tons of straw; potatoes, four acres, yielding five hundred bushels; turnips, one acre, yielding four hundred bushels; and two acres in cabbage and other garden vegetables. Seventy-five acres were in grass, yielding a hundred and sixty tons of hay; twelve acres have been ploughed, and sown with winter rye for next year's crop; and forty acres were ploughed in the fall, to be cropped next year. The neat-stock at the present time is forty-three head, included in which are two pairs of large oxen, being stall-fed, and nineteen cows. There are ninety swine of the Berkshire breed. The herd of cattle has nearly doubled since its reduction in 1879, and is in good condition, with many choice animals. It has not been sufficiently large,

since the time named, to consume the hay and fodder product of the farm, quite a large part of which has been sold, and a portion of the proceeds expended in purchasing stable-manure at the village, or commercial fertilizers. The receipts and expenditures for the farm, including the payment for student-labor, show a small balance in its favor.

Mr. D. H. Tillson, as farm-foreman, has discharged his difficult and responsible duties with great fidelity, and made unwearied efforts to command success. As usual, the horticultural department has been ably conducted by Professor Maynard. Its business is enlarging and becoming more important every year. The sale of flowers, bedding and potted plants, shrubs, ornamental trees, fruit-trees, and fruits, is quite large, aggregating, during the last season, about four thousand dollars. What may be called the business of this department is carried on at a profit, and would show a decided balance in its favor; but this balance is more than consumed in the support of the Durfee Plant-House, which is little but a show-house, returning small revenue, though of much interest to the public, and very valuable for study and instruction. For further information of this department, reference is made to the annexed report of Professor Maynard. During the past year there have been the following changes in our corps of instructors. Professor William B. Graves, who for six years occupied the chair of physics and mathematics, and discharged its duties with fidelity and success, resigned his position in August to take a situation at Phillips Academy in Andover; and the place has been temporarily filled by the employment of Professor Charles L. Harrington, whose course here has fully sustained his reputation as a successful and enthusiastic teacher. The detail period of three years of Lieut. Charles Morris, as instructor of military science and tactics, expired the 1st of September, and he returned to his regiment: the United-States Government detailed Lieut. Victor H. Bridgman to the place, and he has entered upon his duties in such a manner as to give bright promise of the greatest efficiency and success. These new men have apparently imbibed to the full of the Agricultural College enterprise, have harmonized perfectly with the previous members of the faculty, giving their sympathy and co-operation in all their trials and successes. Annexed is a

report from each on the present condition and wants of their respective departments. The other members — Professors Goodell, Goessmann, and Maynard — have as usual put forth every effort to maintain the efficiency of their departments, the general *morale* of the college, and a high standard as an educational institution. Though the duties of the permanent members have been increased to a dangerous point since 1879, they have found it impossible to give instruction in all the branches required by the curriculum; and it has been necessary to employ specialists to take the courses in geology, zoölogy, and veterinary. There has been no material diminution in the number of students. At the opening of the college year, nineteen were received to the freshman class in the regular course, one as a special, and five for the post-graduate course. The students as a whole have availed themselves of their privileges, and performed their required duties with cheerfulness and alacrity, have respected the regulations of the college, been earnest in contributing to maintain its high character, and enthusiastic in supporting its distinctive features. The present winter they have originated and carried into successful operation a course of weekly evening lectures from specialists in the science and practice of agriculture, which the public are invited to attend, and which cannot fail of being highly beneficial. The anniversary exercises were of a superior order. They were attended by his Excellency the Governor, and staff, by the members of the Board of Agriculture, the friends of the college and graduates, many of the alumni, and more generally than usual by the public. It is evident that these exercises are yearly attracting more and more attention, that the circle of their influence is enlarging, and that the agricultural portion of the community are coming to consider the Commencement exercises of the college an occasion of great import. The Farnsworth prizes for excellence in declamation were awarded, — the gold medals, to Charles T. Conger of New York of the sophomore class, and George Cutler, jun., of Amherst of the freshman class; the silver medals, to Homer J. Wheeler of Boston of the sophomore class, and Elisha A. Jones of Rockville, Mass., of the freshman class. The Grinnell prizes to the graduating class, for the best written and oral examinations in agriculture, were awarded, — the first, of fifty dollars, to Henry W.

Wilcox of Nawiliwili, S.I.; and the second, of thirty dollars, to Austin Peters of Boston. The graduating class numbered nineteen, who, having completed the required course of study and examinations, received the degree of Bachelor of Science; and seven of the number, who were matriculants of the Boston University, received the diplomas of that institution. A valuable addition has been recently made to the natural-history cabinet of the college by a donation from Winfred A. Stearns, a young naturalist of Amherst. It consists of many thousand specimens in the departments of mineralogy, entomology, and conchology, and a large collection of the nests and eggs of the birds of New England. Want of room and cases have seriously interfered with its arrangement in suitable order for exhibition and study; but yet it is a great acquisition to this department. For want of means the improvements of the year on the land or buildings have been few, and those more in the direction of preserving what we have from unavoidable decay and deterioration than of changes for permanent improvement. On the farm, work in gradually developing the arranged system of drainage, and breaking up and subduing the uncultivated land near the western boundary, was discontinued in the fall of 1879, and has not been renewed; but, as already stated, fourteen acres of the pasture, which was becoming infested with small shrubs and coarse grasses, have been ploughed and reseeded, and there has been much grading and reseeding done near the L. D. Cowles homestead. The Durfee Plant-House, which was getting seriously out of repair by the settling of the arches of the roof, and the decay of the sills, the floors, and benches, has been repaired by lifting the arches, and supporting them with iron standards, putting down new floors, benches, and shelves, and painting the entire structure inside and out; the whole cost of which has been more than six hundred dollars. At an early day it will require further repairs on the foundations, sills, and walls of the propagating-pits. By act of the last Legislature, the Massachusetts Central Railroad was granted the right of way to cross the College Farm; and the surveys have been made, and the permanent line definitely located. The line runs from the south farm-bound in a north-west direction on a long curve, through the full width of the estate, about thirty rods west of the

college buildings and farm-barn, and between the latter and the pastures. The road does not come at grade with the surface to any extent, but consists of cuts and fills, and will be a serious disarrangement of our system of field-plotting, will cause no little inconvenience in the management and care of the farm-stock, and the general operations of carrying on the west half of the farm. The land-damages have not been adjusted, though propositions have been made by both parties. It is believed that a settlement will soon be made, and reasonable compensation given (direct and indirect) in money and privileges; but it must result in a lasting injury to the estate.

When the Commonwealth received the endowment fund of the college from the United States, it was stipulated in the compact that the State should provide all the buildings needed by the institution, and keep them in repair, without using any of the fund, or the income thereof, for that purpose. In 1867 and 1868 funds were provided by the State and the town of Amherst for the erection of such structures as were deemed necessary. Some of them were built rapidly to meet existing emergencies; and thirteen years' use, and perhaps, in some cases, the original employment of improper material and poor workmanship, have caused much deterioration and need of repair. The State having made no provision for such necessities, the trustees, to prevent serious losses, have deemed it their duty, during the last two years, to expend sixteen hundred dollars for this purpose from their general income. The money thus expended was greatly needed by the different educational departments; and nothing but the imperative necessities of the case could justify its employment in this manner. Similar work is still needed; and we respectfully suggest to the consideration of the Legislature whether the spirit or letter of the compact with the General Government can be complied with, only by the State assuming this obligation, and employing the income exclusively for educational purposes.

WANTS OF THE INSTITUTION.

As the law required military tactics and drill to be taught in the college, it was deemed best, that, so far as possible, this instruction should be given in the winter months, when

the students could not have full employment on the farm; and, as winter drill in the field was impracticable, a drill-hall was provided in the third or attic story of the laboratory building. But the marching and evolutions of the battalion, continued for ten years, have so strained and weakened the structure, as to create serious apprehension of its complete ruin: therefore, for three years, its use for this purpose has been discontinued, and the winter drill, so important in the general system, has been practically abandoned. Estimates were made, by a practical builder, of the cost of such repairs and supports as were considered necessary to make the structure secure and safe to the battalion; but it has been beyond our power to make the necessary repairs and improvements. The agricultural department has always suffered for want of proper accommodations and appliances, and for apparatus and objects for lecture instruction. To make it thoroughly effective and useful, the professor should have an ample lecture-room, with cabinet-rooms adjoining, where specimen-crops, tools, implements, and farm machines and appliances in all its departments, could be collected and arranged for use before his classes, and for private study. Such a cabinet would cost no money, but would be of incalculable advantage to the students, and a place of resort and instruction to the farmers of the State. A suitable building could be erected for fifteen thousand dollars; and on the earth in its basement a military drill-room could be provided, for winter and stormy weather, which would be convenient, and beyond the possibility of injury by the marching and evolutions of the cadets. By this method the expense of repairs on the present hall would be avoided; and it could be used for other college purposes, and the suffering want of the agricultural department supplied. Repairs and refitting are needed at the boarding-house; and the kitchen and dining-room furniture, which has been in constant use fourteen years, should be replaced by new. The library is far from being what is needed, either in the number of its volumes or its departments; and it is thus, not because the trustees do not appreciate the great value of books to both instructors and students, but because of their inability to replenish it from year to year with new and standard works for culture, reference, and instruction. When the college was opened, the

trustees of Amherst College kindly offered the use of their extensive and valuable library to our students and faculty on the same conditions as to their own. This generous offer has been availed of quite freely, and its advantages highly prized; but there is an extensive line of works specially needed, and adapted to the wants of the students of the Agricultural College, which are not found there, and its distance is such as to make its use a great inconvenience. Some means should be provided for making regular additions to the college library, and a suitable room for its keeping; and the college will be far from having its necessary equipment until this is done. We thus express our views of the wants of the institution committed to our care, with the feeling that it is doubtful if the general public, or even the Legislature, fully appreciate the magnitude of the enterprise, or the skill, intelligence, and means necessary to carry it forward successfully, or in a manner creditable to the State. As was intended by its founders, the college is an educational institution, with its distinct departments, apparatus, cabinets, and instructors, like other New-England colleges, but with the addition of technical courses relating to the theory and practice of agriculture, and other industrial arts, to make which efficient and useful requires of its trustees the same executive care and oversight in all details, the same financial provisions, and the same responsibilities in kind and extent, as are required of the trustees of other colleges. The farm is a very large one, with its buildings, stock, tools, teams, crops, and business operations of all kinds, like other large farms, and, owing to the peculiar circumstances of its connections and objects, requires more than ordinary care, foresight, and responsibility. The horticultural department, with its conservatories, nurseries, fruiteries, and landscape-gardening areas, is a business operation of no small magnitude. Each of these divisions of the enterprise is indispensable as a part of the general system of the institution; and each, from a business stand-point, is of sufficient size and importance to monopolize the time and thought of an able board of direction, the skill and energy of the best executive talent; and the whole and each is enlarged and complicated by the necessity of making each contribute to the technical education of the students. In addition to this, there is a

somewhat pronounced public opinion that constant effort should be made, and expenses incurred, for the benefit of the general agriculture of the State, by carrying forward investigations to demonstrate and establish principles of practical importance. If the entire institution consisted of the college proper, with the indispensable professorships supplied with the necessary appliances and apparatus to make the instruction what it should be, the present income of the college would be inadequate to its proper support; and, as the farm and horticultural departments must be used to a greater or less extent to give technical education to students, they cannot be relied upon to contribute to this purpose. Our efforts the last two years to bring the college to the highest efficiency having convinced us of its impossibility, with only its present income, it was thought desirable to institute measures to increase the endowment fund to such an amount as is required to yield an ample and reliable revenue. Therefore a joint convention to consider the subject, consisting of his Excellency the Governor, and Executive Council, the Board of Trustees, and the Board of Agriculture, was held at the college on the 22d of last June.

Gov. Long acted as president of the convention, and called upon Hon. Daniel Needham of the Board of Trustees to make statements showing the condition and wants of the college, and the reasons for calling the convention. In response, Col. Needham passed in rapid review the history of the agricultural colleges of Europe, and the great benefit resulting therefrom; the early efforts to establish them in this country, alluding in particular to the commission given by the State of Massachusetts in 1851 to Dr. Hitchcock, to examine the agricultural schools of England, France, and Germany, and his report thereon to the Legislature. He traced with some detail the subsequent efforts to establish agricultural schools in several of the States, and the gradual and decided change in public opinion in their favor until about 1860, which reads as follows: —

"Hon. Justin S. Morrill of Vermont, then a member of the House of Representatives, brought the matter again before Congress. It was discussed from time to time — now prostrated by defeat, and again bidding fair promise of success — until 1862, when the Act upon which the present Agricultural College is based was passed by both Houses of Congress, received the signature of the President, and became a law.

"As is well known, the law provided grants of lands, proportioned to the population in the several States, as a fund for the support of agricultural colleges. Among the provisions of the Act, was one that military tactics should be taught in the college. I think this has been one of the most difficult obstacles we have had to overcome. The people have found it difficult to see the connection between agriculture and military tactics. Many a severe jest has been made, based upon the provisions of this requirement. But the provision is in the law, and we cannot go back of it. It is no fault of the State that it is there; it is no fault of the trustees that it is there: and perhaps, as we are a nation of citizen soldiers, keeping no standing army, and forever dependent upon the citizens in case of rebellion or invasion from a foreign foe, it is well that the requirement is made; for, without a soldier's education, the American citizen cannot perform the full duties of citizenship.

"In 1863 the Massachusetts Legislature considered the Act providing for the establishment of colleges in the several States. It was discussed in committee, and reported favorably. It was discussed in the House and Senate, — discussed carefully in detail, every objection was considered and weighed and overcome; and the bill making provision for the Massachusetts Agricultural College was passed by both Houses of the Legislature, received the signature of the Governor, and became the law of the State. The bill, fully, unequivocally, and unreservedly, accepted the national bounty and the terms of the congressional Act. The State accepted the contract. If it was a mistake, it is now too late to rectify it. The Legislature and the executive head of the State entered into a solemn and deliberate contract with the Nation. That responsibility once accepted was accepted for all time. Massachusetts will not go back of her contracts: she is no repudiator. She cannot shift this college off to other shoulders. She cannot make it a part of another institution: it is an independent organization, — chartered and created for independent work; and the time to regret it has long since passed.

"In the bill accepting the grant, a Board of Trustees was elected by both branches of the Legislature. The gentlemen elected were carefully selected, and were elected without their request or solicitation. They accepted the responsibility: it was a great one, for an agricultural college was a new thing, an experiment, in Massachusetts. It had older and richer institutions to compete with, it had prejudice from the people to combat, it had a plan to make and shape for which it had no precedent. The agricultural colleges established by despotic governments were no model for the college in the republic of America. So they felt their way — slowly, little by little — in great doubt, uncertainty, and darkness, seldom with great confidence, except in the fact that the principle was sound, the object good, and that in the end the college would justify the act of its founders.

"The town of Amherst, in its recognition of the value of the institution, invited the trustees to locate it within its borders, and, as an inducement, offered seventy-five thousand dollars. After great deliberation the offer was accepted. In this liberal offer the people of Amherst had the right to expect that the college would be well maintained, and that both

State and trustees would see that no stone be left unturned to secure success.

"The college was not richly endowed, and the number of students was not large. For this reason poverty met the trustees at every turn, — in the compensation of professors, in the management of the farm, in the erection of houses for the faculty: but this poverty was no fault of the trustees; they had not agreed, neither could it be expected, that they would furnish money from their own pockets to make good deficits that might occur. So from time to time appeals were made to the Legislature, to which every year a full report of the management and condition was made by the trustees.

"By and by legislators grew weary of these annual or bi-annual calls. The press took up the complaint. Denunciations of the college were in every-day editorials, and at times the public press seemed to be striving to see which could get the lead in its abusive attempts to set forth the uselessness of the State Agricultural College.

"In 1870, or thereabout, the Legislature made a change in the election of the members of the Board of Trustees. Theretofore elected by the Legislature, it was now provided that the board should be self-perpetuating, and in this way brought into harmony with all educational boards that had been chartered by the State. It was thought, too, that this change would relieve the State of the burden of the college, and that the new Act would shift responsibility.

"The trustees made no interference with the new action of the Legislature. They had not asked it; they did not oppose it: but, knowing the history of the college, they knew that State responsibility could not be thrown off. Acts might be passed, the statute-book might be covered with resolutions; but this great fact would remain the same. It was too late — too late. By solemn obligation and deliberation the responsibility had been assumed, the lands granted by the Government had been sold, the gift of the town of Amherst had been accepted, and there was nothing to be done except for the State to fulfil its part of the contract.

"The trustees under the new Act of legislation continued to struggle on. The press was against them, and many of the leading farmers of the State preferred to make them and the college the basis of a joke rather than give a word of encouragement.

"At last, determining to test the popular will, free scholarships were offered. That was three years since; and, to their delight, the college for the first time was filled. Then it was discovered that the people were beginning to appreciate the college, and that prejudice was giving way. But in another year it was found that the finances of the college would not justify free scholarships, and with deep regret the trustees were obliged to renew the former policy. The college classes relapsed into their former small numbers, and the taunt of a want of appreciation or absolute uselessness was revived by the press.

"But was it the fault of the trustees that the college was poor? Had it been for once only that they would be called upon to bridge over a deficit, or even twice, — and then they could have assurance that the college

would move on with ease and certainty, — they would have gladly put their hands in their pockets, and made good the needed funds; but, if free scholarships were to be given the public, there would be no end to this demand, and therefore necessity compelled the change which was most reluctantly made.

"But one thing is now established, and established beyond question, — the farming public have yielded their prejudices, and the Agricultural College is recognized as one of the great means demanded by our advancing civilization. The only impediment now is our poverty. With means we can again offer free scholarships, and with free scholarships our college will be filled.

"As a means, then, for meeting our great want, and removing the only remaining obstacle in the pathway of the State Agricultural College, I present the following resolution: —

"*Whereas* The opportunity afforded for free tuition three years since fully demonstrated that the Agricultural College was appreciated by a large proportion of our farming population by the increased numbers who sought and secured membership; and

"*Whereas* The increasing necessities of our civilization demand free scholarships of all our young men who are ambitious to secure practical education, and whose circumstances do not favor the expenses of tuition; and

"*Whereas* The only remaining obstacle in the development and prosperity of the Agricultural College is found in the small means at its disposal, thereby preventing the trustees from continuing the liberal policy of free scholarships so successfully inaugurated three years since: therefore

"*Resolved*, That a committee be appointed to consider the perfect means for the establishment of a large permanent fund for the College, in addition to its present endowment, that its usefulness shall be made commensurate with the designs of its originators, and its scholarships brought within the reach of all the youth of the Commonwealth."

The resolutions were unanimously adopted, after full and free discussion. The following gentlemen were appointed as a committee to consider the entire subject, and to submit a plan at a subsequent meeting of the college trustees: Hon. Daniel Needham of Groton, Hon. William Knowlton of Upton, Hon. George Taylor of Chicopee, Lieut.-Gov. Weston of Dalton, and Hon. C. L. Flint of Boston. By the suggestion of Gov. Long, the following resolution was passed. and the convention adjourned: —

Resolved, "That the State Board of Agriculture be requested to require all agricultural societies in this State receiving bounties to support, at an expense not less than seventy-five dollars, one student residing within its limits at the Massachusetts Agricultural College, and that, in case no student is so supported, such amount shall be withheld in the payment of the agricultural bounty to said society, and applied to the general uses of the college."

The committee attended to their assigned duties; and at the annual meeting, by their chairman, Hon. Daniel Needham, reported the following plan: —

"That a fund of one hundred thousand dollars be raised by subscriptions of one thousand dollars each, payable in ten instalments of one hundred dollars a year, with interest at four per centum on all unpaid balances, until the entire sum is paid; and that, whenever said one hundred thousand dollars shall be paid, it shall be handed over by the committee to the treasurer of the college as a permanent fund, the income of which shall be used under the direction of the Board of Trustees.

"That the conditions upon which this fund shall be bound shall be as follows: 1st, The present system of electing trustees for filling vacancies shall not be changed; 2d, That the committee shall be perpetuated by the filling of vacancies by the Board of Trustees during the period of ten years during the time which the subscription shall be open."

The report was accepted, and laid on the table; and it was voted that the plan should be considered in detail, and measures perfected at an adjourned meeting for its execution.

The trustees of the college, though a legal "body corporate," are simply the agents of the State, with duties and powers clearly defined by law. In the statute of Congress, the great aims and purposes for which the college endowment was provided, and the obligations assumed by the State in accepting it, are fully set forth; and in the statute of the State the details of administration by which it is proposed to realize those aims are defined, even to the course of study to be pursued, and the proportion of time to be given to each. The responsibility of the trustees is confined to an economical expenditure of the funds committed to them for purposes expressly defined, and a faithful adherence to the established system. If this is incapable of producing the designed result, or if the income from funds is inadequate to sustain and develop the system, the responsibility must belong to the State. The experience of fourteen years has demonstrated that the plan of organization is no more extensive, its grade is no higher, than was contemplated by the donors of the endowment, or than is essential to the attainment of the ends sought. Therefore as it exists, in all these respects, it should be supported and maintained.

Respectfully submitted by order of the trustees.

LEVI STOCKBRIDGE, *President*.

AGRICULTURAL COLLEGE, AMHERST,
Jan. 27, 1882.

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